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VOLUME 24 APRIL, 1941 NUMBER 4

ON THE PATHOLOGY OF CAROTID-CAVERNOUS ANEURYSMS (PULSATING EXOPHTHALMOS)

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Baltimore

The last word upon the clinical features of carotid–cavernous-sinus aneurysms has probably been said by C. H. Sattler in his exhaustive publication on pulsating exophthalmos (Handbuch der gesamten Augenheilkunde, 1920). It is unlikely that more than minor variations in the clinical expressions of this lesion will be found. A method of curing these desperate lesions when they proved to be refractory to the simpler surgical efforts heretofore in vogue was recently presented by one of us (W. E. D.). The hazards of any form of surgical treatment of such cases are attested by the two pathological specimens to be described, obtained at necropsy in the only two fatal cases in the series. These dangers are in part due to the risks of the operative attack *per se* and in even greater degree to the variable and unpredictable vascular patterns of the circle of Willis, upon which the development of an adequate collateral arterial circulation to the brain is dependent. The age of the patient is always an additional risk which unquestionably increases with the years. However, because of congenital variations of the circle of Willis, youth is no assurance against this danger.

It is principally with the anatomical details of carotid–cavernous-sinus aneurysms that this publication is concerned. Two post-mortem specimens are presented: the patient in one case died from rupture of the carotid artery when a clip was placed intracranially; in the other, probably from multiple infarcts in the brain stem. The relationship, if any, of these infarcts to the operative application of a partially occluding band on the internal carotid artery in the neck is not clear. The temporary cerebral anemia in the second case was doubtless due to a minute posterior communicating artery on the affected side and to a small anterior cerebral artery by which alone a collateral arterial blood supply was possible. At the time of Dandy's recent publication on carotid-cavernous aneurysms (1937), 29 pathological specimens of carotid-cavernous arteriovenous aneurysms were recorded in the literature, most of them inadequately described, and in the great majority it was merely noted that an opening existed in the carotid artery within the cavernous sinus. It has previously been emphasized (1) that in no other part of the body does an artery actually traverse a venous channel and thus lend itself so readily to the development of an arteriovenous fistula, and (2) that within the cranial chamber large arteries and veins are not contiguous and, therefore, (3) in no other part of the cranial chamber can a ***traumatic*** or otherwise ***acquired*** arteriovenous fistula develop. All arteriovenous aneurysms within the brain (and there are many of these) are, therefore, of congenital origin. Carotid–cavernous-sinus aneurysms may arise either as a direct or indirect result

of trauma to a normal or abnormal (preexisting aneurysm) carotid artery within the cavernous sinus; or they may result from spontaneous rupture of an arteriosclerotic internal carotid artery or a preexisting aneurysm of this artery within the cavernous sinus. Of the 29 postmortem specimens, 16 were presumably of traumatic, and 13 of spontaneous origin. It is not entirely unlikely that in some of these entered as traumatic there may well have been, as possibly in one of our cases, a preëxisting aneurysm that was already on the point of rupture, and the trauma may have had little, or perhaps no, bearing upon its production. There are, in fact, reasons to believe that seriously defective walls of the internal carotid artery are more common in its intracavernous portion than in the neck or intracranially.

Case reports

Case 1 (U-135247). *Diagnosis.* Bilateral carotid–cavernous-sinus arteriovenous aneurysms—presumably posttraumatic (16 years' duration).

Treatment. (1) Fascial band applied to left internal carotid artery (April 18, 1938). (2) Portion of internal, external, and common carotid arteries about band area removed 58 days later. (3) Attempted application of silver clip to internal carotid artery intracranially (death five hours later). (4) Necropsy 67 days after application of the band, and nine days after removal of portion of the arteries.

A colored male, aged 53 years, entered the Johns Hopkins Hospital on March 17, 1938, because of bilateral carotid–cavernous-sinus arteriovenous aneurysms, from the effects of which he was almost blind. He had long been a patient in the dispensary, where he was treated for syphilis of the cardiovascular system. His blood pressure was 160/105 in 1932. He had arteriosclerosis and dilatation of the aorta.

The present illness began 16 years ago (at another time he said 11 years ago) following an injury to the head. The history of trauma is none too dependable. Whether or not his pulsating exophthalmos dated from that time is not certain; he remembered very little about the injury and did not know whether he was

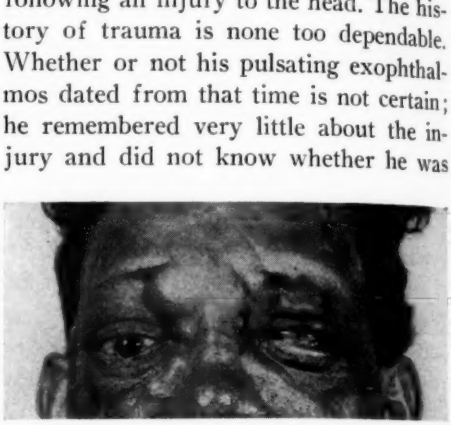

Fig. 1 (Dandy and Follis). Case 1. One month before operative occlusion of the left internal carotid artery. Pulsating exophthalmos, right eye. Tortuous, bulging vessels over forehead, more marked on the right.

unconscious afterwards. However, at that (indefinite) time the left eye turned outward and he became aware of a noise in the head. On further inquiry into the hospital records it was found that he did have an accident in 1932. This great disparity in dates is indicative of the patient's mental unreliability. He was very forgetful, and all his statements concerning past history were so changeable as to be entirely uncertain.

He was first seen in the Johns Hopkins Dispensary in December, 1930, and again in 1932. At the time of the latter admission he complained of a continual roar in the head, dizziness, ringing in the left ear, and poor vision in both eyes. The objective findings were: bilateral strabismus, slight bilateral exophthalmos, ectropion of the left lower lid, paresis of both sixth nerves, and total paralysis of the left third nerve. He said he had been advised from time to time to have something done, but as long as any vision re-

mained he was averse to surgical treatment.

He again entered the Johns Hopkins Hospital, March 17, 1938, following a drunken brawl (fig. 1). He was semiconscious, but his condition rapidly cleared. At that time there was marked proptosis of the right eye, none of the left. (Proptosis was not measured.) The right eyeball pulsated strongly and synchronously with the pulse; the left did not. There was marked convergent strabismus in the left eye, but none in the right; movement of the left eye was impossible. Tremendous tortuous bulging vessels stood out over the forehead on both sides, but much more on the right. There was a big bed of pulsating vessels along the bridge of the nose; all of these vessels pulsated strongly. A thrill was palpable over the vessels and a loud murmur heard over practically the entire head, but more intensely over the temporal and frontal regions. The pupils were of average size: that of the left eye barely reacted to light; that of the right reacted somewhat better. The optic discs were atrophic and pale but sharply defined, the veins engorged and tortuous. The blood pressure was then 176/100. Compression of the right carotid artery in the neck did not affect the bruit nor the size of the vessels over the forehead. Obliteration of the left carotid artery modified but did not entirely stop the loud bruit; there remained a slight humming sound. Following compression of either internal carotid for half a minute the patient became dizzy.

The patient was entirely blind in the left eye and could only count fingers with the right. Both eyes were turned inward toward the nose, the left much more than the right.

One month later the patient was squeezing a furuncle on the nose when he opened one of the large vessels. The bleeding was quite severe; he came at once to the dispensary where pressure was applied and the bleeding controlled. Frightened by the possibilities of further hemorrhages he was eager for surgical intervention.

OPERATIONS

First, April 16, 1938. Partial occlusion of the *left* internal carotid artery by a band of fascia lata (W. E. D.).

One could only assume that the arteriovenous fistula was on the left side because (1) the bruit was markedly affected by closure of the left internal carotid artery in the neck; that of the right had no effect; and (2) the third-nerve palsy was complete on the left. On the other hand, the exophthalmos was only on the right, and the tortuous pulsating vessels were on the right. It was, therefore, necessary to assume that the left ophthalmic vein was thrombosed.

Since it was clear from the compression test that total ligation of the internal carotid artery in the neck could not be tolerated, partial occlusion of the internal carotid was performed under local anesthesia. The internal carotid artery was very large and pulsated strongly; it was at least twice as large as the external carotid artery. The fascial band was placed around the internal carotid artery just above the bifurcation and sutured when it had reduced the artery to approximately one third of its original circumference. Pulsation and a thrill were still present above the band, but the difference in the degree of pulsation above and below the band was very marked. The patient was carefully watched before the band was permanently fixed, but there were no symptoms. He immediately realized the great diminution of the noise in the head, but it was still present.

The patient was discharged 10 days

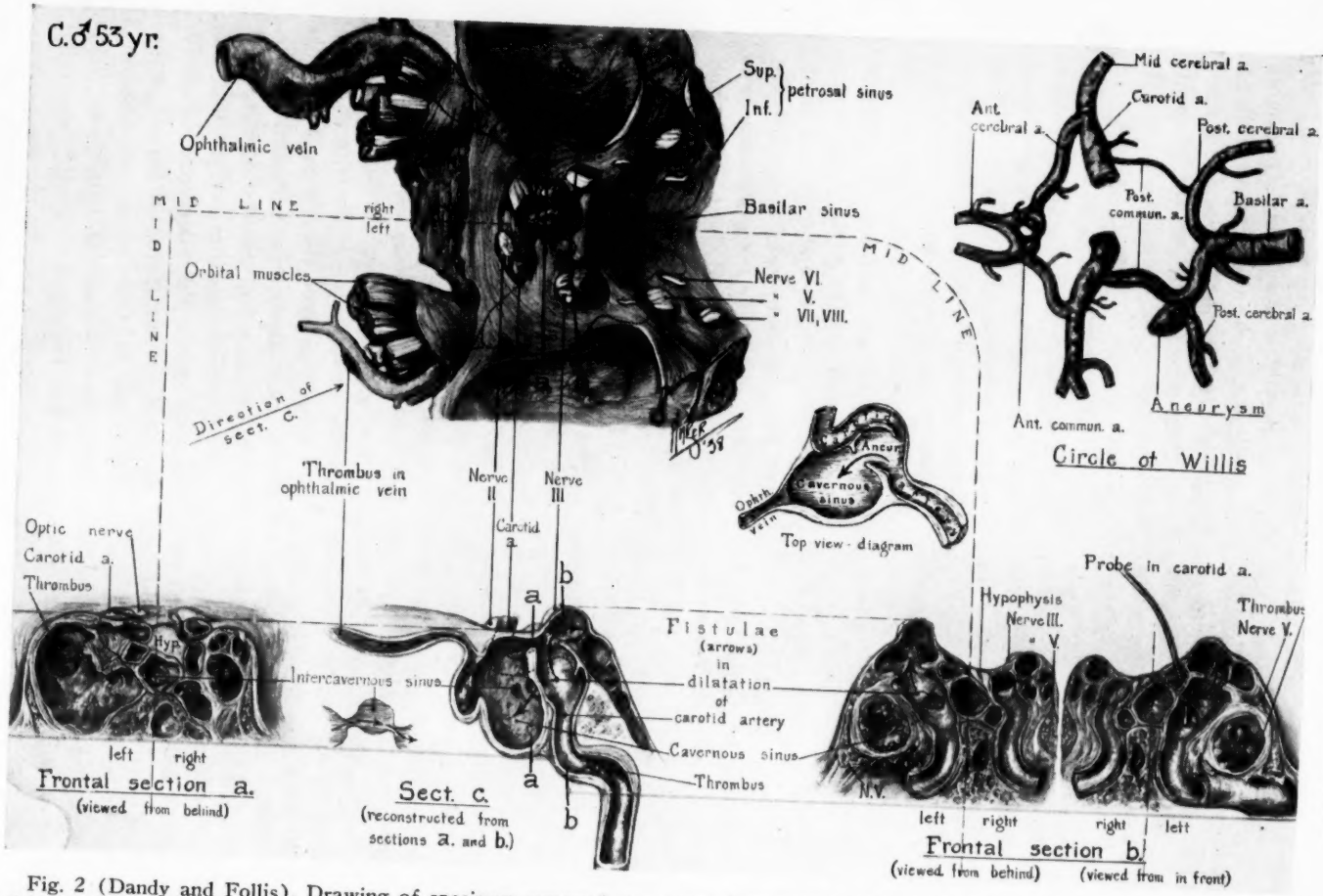

Fig. 2 (Dandy and Follis). Drawing of specimen removed at autopsy from case 1. Two frontal sections have been made: "aa," through the mid portion of the hypophysis and "bb," about 6 mm. posteriorly, just anterior to the posterior clinoids. Frontal section "a." shows large cavernous sinus on left side (see fig. 3). Frontal section "b." shows two openings in internal carotid artery which lead into cavernous sinus. Section c., a lateral reconstruction, shows course of internal carotid in sphenoid bone and cavernous sinus together with two fistulae (arrows).

later, after an uneventful recovery. The bruit remained, perhaps somewhat diminished, but still strongly heard over the entire head.

The patient was readmitted on June 14, 1938, two months after the partial ligation of the carotid artery in the neck. The size of the vessels in the forehead and eyes and the pulsating exophthalmos were practically unchanged from the findings at the first admission. The blood pressure was now 230/105. Compression of the artery in the neck was well borne for five minutes without cerebral symptoms.

Second operation, June 15, 1938. Excision of part of left internal carotid artery with band. Total occlusion of internal carotid.

The old wound was reopened under avertin anesthesia. The carotid artery was surrounded by a very dense scar which made the dissection difficult. The vagus nerve and the jugular vein were tightly matted to the artery and required sharp dissection for their liberation. The jugular vein was opened during this process and ligated. The internal carotid artery was totally occluded with a silk ligature just above the scarred area. After this the internal carotid artery, the external carotid artery, and the common carotid artery were closed with silk sutures and the intervening trunks (containing the old band) were removed in one piece. It is worthy of note that no change occurred in pulse, blood pressure, or respirations during this procedure. The patient's postoperative course was uneventful.

Nine days later, June 24, 1938, an attempt was made to place a silver clip on the left internal carotid artery intracranially. The artery was so large that the clip which had heretofore been used in other cases would not straddle the vessel and in an attempt to force it with a little pressure, the calcified artery tore. Although the immediate bleeding was terrific, it was quickly suppressed with the spatula and both ends were clipped without injury to the circle of Willis. But the hemorrhage into the posterior fossa had been sufficient to cause death five hours later.

PATHOLOGICAL REPORT (Autopsy No. 15915)

The autopsy was performed 14 hours after death. Aside from cardiac hypertrophy (510 grams), moderate arteriosclerosis, and pulmonary emphysema, all the important gross and microscopic pathological changes were found in the cervical and cranial vascular system. It should be noted that the partially occluding fascial band had been placed on the internal carotid artery just cephalad to the bifurcation 67 days before death, and the section of the arteries including the band had been removed nine days before death.

Arteriovenous fistulae. The entire sphenoid bone together with the anterior portion of the occipital bone was removed, and two transverse sections were made through the specimen (fig. 2, a, b). The first was through the stalk of the hypophysis, and the second just anterior to the posterior clinoid process, making it possible to see both carotid arteries and both cavernous sinuses.

Description of specimen (fig. 2). In its course through the foramen lacerum the wall of the left internal carotid artery and related structures was so greatly thickened that quite a mass had been formed; the thickness of the wall (2 mm.) was about three times the normal, but its lumen (4.5 mm.) was not affected and in size equal to that of the opposite side. There was a small, flat, partially obliterating thrombus within the artery in this region; this may possibly have been related to the greater thickness of the overlying arterial wall. After the first

...together with two fistulae (arrows).

Fig. 3 (Dandy and Follis). Photomicrograph (low power) of histological preparation through center of the hypophysis to show the internal carotid artery with its dilated portion and large cavernous sinus.

Fig. 4 (Dandy and Follis). Photomicrograph (higher power than in figure 3) of wall of carotid artery to show disappearance of elastica as wall becomes dilated.

bend in the artery as it entered the cavernous sinus, the vessel remained unchanged in size for a distance of 1.25 cm.; at this point the anterior, posterior, and lateral walls diverged, forming a sac measuring 1.5 cm. in its greatest diameter, and 6 mm. in width; the major bulge was in the anterior wall of the sac (artery). In the lateral wall of the aneurysmal sac was a small calcified plaque. On the anterior wall of this sac and at a point 5 mm. above its origin was the first of two openings into the cavernous sinus. It was roughly oval and measured 4 by 7 mm. Its margins were slightly irregular but smooth. A second fistulous opening from the aneurysmal sac was approximately of the same size; it was 1 cm. above the first opening, and on the superior wall of the sac. The margins of this opening were also somewhat irregular but smooth. The walls of the aneurysmal sac were much thinner that those of the carotid artery and eventually for this reason it became difficult to tell where the artery terminated and the thickened walls of the cavernous sinus began. The superior continuation of the carotid artery from the aneurysmal sac is shown by the entering probe (fig. 2, frontal section b). It is worthy of note that, in cross section, the continuation of the internal carotid artery above the aneurysmal dilatation was distinctly smaller than that of the opposite side and was triangular in shape, owing to the compression on all sides by the enlarged cavernous sinus and the aneurysmal sac (fig. 2, frontal section b).

Microscopically, the thickening of the left carotid artery at its entrance into the cavernous sinus was found to be due to an increase in the size of the media. The elastica was intact as the artery entered the skull. However, at the point where the lumen began to widen, the elastic layer completely disappeared (figs. 3 and 4) and the wall of the dilated artery was composed for the most part of elongated muscle cells and hyaline connective tissue. There was no evidence of any inflammatory change. The wall of the left carotid above the dilatation was normal.

The cavernous sinus, left side (fig. 2). The cavernous sinus was a very large sac measuring 2.5 cm. (vertical) by 2.5 cm. (width) by 1.5 cm. (anteroposterior). A mesial pouch of the cavernous sinus extended beneath the internal carotid artery and pushed the hypophysis toward the opposite side; the left border of the hypophysis just reached the midline. This pouch also elevated the intracranial portion of the internal carotid artery and this in turn produced sharp angulation of the optic nerve where it was fixed at the optic foramen. The wall of the cavernous sinus on the left side was composed of dense, hyaline connective tissue. In places there were bluish staining granules of calcium. Hyaline thrombus was adherent to the wall; in the anterior portion there was a fresher thrombus undergoing organization.

A second round pouch (1 cm. by 1 cm.) of the left cavernous sinus lay just over fistula no. 2, and projected intracranially through the opening where the third nerve entered the wall of the sinus. It was sharply defined and looked like a little tumor. This venous pouch flattened the oculomotor nerve, which was spread like a fan over its anterior border. The normal trabeculae within the cavernous sinus had been entirely destroyed so that a single big smooth cavity resulted. The walls of the sinus were everywhere greatly thickened, in places to 2 or 3 mm., and in one place were definitely calcified.

The *right cavernous* sinus was roughly a third as large as the left and contained numerous trabeculae. The two pouches that were present in the left were also represented here but both were very much smaller. The places at which these pouches developed were doubtless the

weak spots in the wall of the cavernous sinus.

The *intercavernous connection* is interesting (fig. 2, frontal section a.) Immediately beneath the hypophysis was a roughly oval venous sac measuring 1 cm. by 8 mm. This sac communicated with each cavernous sinus by an opening about 2 mm. in diameter. This was the only direct communication between the two cavernous sinuses. A very wide patent basilar sinus afforded much greater communication, although in a slightly more indirect way; that is, downward behind the posterior clinoid process.

Venous tributaries. The superior ophthalmic vein on the *left* was completely thrombosed from its mouth in the cavernous sinus to the most anterior part of the orbital contents (5 cm.) that remained after removal at necropsy. No trace of an inferior ophthalmic vein could be found. The lumen of the thrombosed vein was only about 1 mm. wide at the cavernous sinus and about 2 to 3 mm. at its greatest diameter within the orbit. The wall of this thrombosed vessel was as thick as the normal carotid artery. Microscopically, this vein presented an interesting appearance. There was an adventitial layer a little thicker than normal. Next was found a layer of connective-tissue cells together with a few muscle cells which probably represented the media. Farther in, were numerous thin-walled vascular channels all infiltrated with lymphocytes. Between these and the lumen, there was a band of hyaline connective tissue to which organized thrombus was attached.

The right superior ophthalmic vein was enormous (diameter 1.2 cm.), elongated, and tortuous. There was no inferior ophthalmic vein on this side. The walls were not thickened, but were probably actually thinner than normal.

The *inferior petrosal* sinuses were fairly symmetrical blind pouches which did not communicate with the jugular system; apparently no communication had ever existed. The basilar sinus afforded connection between the two inferior petrosal sinuses and indirectly between the two cavernous sinuses was like an hour-glass in shape, the constricting center being at the midline and only 2 mm. in diameter. Trabeculae were present in the *right* inferior petrosal and *right* half of the basilar sinus, but were absent in both of these sinuses on the *left* side.

The superior petrosal sinuses were also blind, roughly symmetrical pouches on both sides; they measured 1 cm. in length and 8 mm. in width. They did not communicate with the lateral sinuses, but ended over the dural foramina conveying the sensory root of the trigeminus. The sphenoparietal sinuses appeared to be absent; at least, extension of the cavernous sinus through either foramina ovale could not be demonstrated.

Arteries. The intracavernous portion of the left internal carotid artery has been described under the fistula. It may be added that this artery was closely applied to the sphenoid bone and the hypophysis except anteriorly, where a bulge in the cavernous sinus projected below the bone and the artery, pushing the latter laterally. On the right, the carotid artery was everywhere fixed mesially. In the other case described in this paper these arteries were closely applied to the lateral wall of the sinus and were separated from the hypophysis by the venous bed.

In the accompanying drawing (fig. 2, frontal section b) the differences in size and position of the intracavernous portion of the internal carotid artery on the two sides are shown. On the *left* the lower portion of the artery was pushed to the midline of the head; on the *right* the artery was pushed laterally at one point by a projection of the cavernous sinus.

Other arterial abnormalities. The mark-

edly abnormal circle of Willis is shown in the accompanying drawing (fig. 2). All of the arteries were full of sclerotic plaques. The anterior communicating artery was double and each trunk as large as the anterior cerebral artery. A small dilatation (aneurysm) bulged posteriorly alongside the right anterior cerebral artery.

The posterior communicating artery on the *right* was small; the one on the *left,* nearly as large as the carotid. The posterior communicating artery was practically continuous with the posterior cerebral artery—a not uncommon finding.

At the junction between the left posterior communicating and posterior cerebral arteries was a sacculated aneurysm that measured 1 cm. by 8 mm. This was unruptured and contained no thrombus. The basilar and both vertebral arteries were very large; the walls contained many calcified plaques.

Thrombi. A well-organized gray single thrombus 1.7 cm. by 1.2 cm. filled the inferior portion of the left cavernous sinus. This thrombus lay 2 or 3 mm. beyond fistula no. 1 and did not, therefore, reach the fistula. The extensive and doubtless much older thrombosis of the left ophthalmic vein has been noted. There was no connection between this thrombus and that in the pouch of the cavernous sinus. A small, flat, partially obliterating (by about one third) thrombus in the carotid just before it entered the skull coincided with the thickened arterial wall. There was no thrombus at any point in the intracavernous portion of the carotid artery.

Brain. When the calvarium and dura were removed, a small amount of blood was found beneath the dura on the left side. The convolutions were slightly flattened but there was no marked pressure cone. A large hemorrhage was observed beneath the arachnoid at the base and especially over the cerebellar hemispheres on their inferior aspect.

The lateral cerebral ventricles were of normal size; a blood clot partially filled the posterior horns as well as the fourth ventricle. On numerous sections of the brain the only lesion found was a small area of punctate hemorrhages in the cortex about the level of the anterior limit of the caudate nucleus on the left. Microscopically, no change that might be referable to the carotid ligation could be made out on the left side. The ganglion cells had normal-appearing nuclei and their cytoplasmic contents showed no change. There were several small arteries with calcified walls in the corpus striatum, on both sides.

Eyes. There was distinct atrophy of the optic nerves. Except for a few thickened blood vessels in the choroid, the remaining portions of the posterior segments of the eyes showed nothing upon histological examination.

Case 2 (U-143515). Admittance, June 10, 1938; death, July 18, 1938.

Diagnosis. Bilateral carotid–cavernous-sinus arteriovenous aneurysms—posttraumatic (three weeks' duration).

Treatment. (1) Partially constricting fascial band on internal carotid artery (June 11, 1938). (2) Removal of band one day later (recovery of symptoms followed). (3) Band replaced 10 days later. (4) Total ligation of internal carotid artery 24 days later (death two days later).

A quite feeble old lady, aged 68 years, had been perfectly well until she had had a fall three weeks previous to admittance. She was stunned momentarily but was not unconscious. A resulting Colles fracture was reduced and a cast applied in another hospital, where she remained seven days. Her right eye was swollen immediately after the accident and there was some protrusion of the eyeball. Since the accident there had been a continuous roar in the right side of her head. Because of the noise and the pro-

truding eye she was brought to the Johns Hopkins Dispensary, where Dr. Frank Ford made the diagnosis of a carotid–cavernous-sinus arteriovenous aneurysm and sent her into the Johns Hopkins Hospital, on June 10, 1938 (fig. 5).

The following positive observations were recorded: (1) Marked protrusion of the right eyeball, with (2) complete ophthalmoplegia, and (3) complete ptosis of the upper lid; (4) marked edema of the conjunctivae of both upper and lower lids and slight eversion of the lids from this cause; (5) over the right side of the skull a loud systolic bruit could be heard. It could be stopped by pressure upon the internal carotid artery, but pressure upon the artery could be tolerated only a few seconds, after which the patient swooned. The exophthalmos of the right eye measured 6 mm. No pulsation could be seen or felt at any time in the protruding eye. The visual acuity was 20/70 in the right eye and 20/30 in the left. There was a temporal quadrantal defect for form and color in the right eye; the fields for form and color in the remaining vision were markedly restricted.

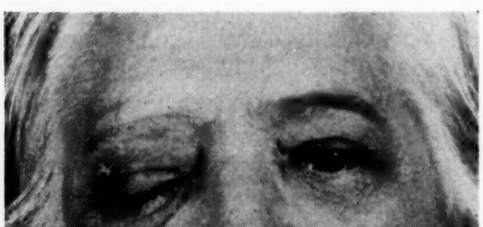

Fig. 5 (Dandy and Follis). Case 2. Shows complete ptosis of right eye with edema of lids, on admission. Note absence of dilated veins over forehead.

At this time there was no protrusion of the left eye, nor was there any fullness nor tortuosity of the veins over the forehead on either side. On account of the subjective roar and the objective systolic murmur we believed that there must be an arteriovenous aneurysm, and that there was no enlargement of the veins of the forehead because of local venous thrombosis. The patient's blood pressure was 150/90.

OPERATIONS

First, June 11, 1938. Under local anesthesia, a band of fascia lata about 1 cm. wide was placed around the internal carotid artery just above the bifurcation of the common carotid (W. E. D.). Aside from the fact that the internal carotid made a complete S-shaped loop in the neck, there were no anatomical variations. Its size was quite normal. In making this loop the artery ran exactly transversely in the neck for a short distance. This same observation had been made in the case of the other patient. There was a tremendous thrill in the transverse portion of the loop, but no thrill could be felt in the arterial trunk just above the bifurcation. At first we thought the transverse portion of the artery was a big vein, as it was distinctly blue, but when the artery was dissected upwards it was found to be simply a loop which when untangled made the artery quite redundant. It was thought that the thrill was probably due to the kink in the vessel from the formation of the redundant loop, but when the artery was straightened out the thrill persisted.

When the band was drawn so as to constrict the artery and then sutured in place there was still pulsation above the constriction. Prior to this we had tied the band a little more tightly, but, as the pulse above was quite feeble, we decided that in view of the patient's age it might reduce the circulation too seriously. The sutures were removed and replaced in order to provide a larger opening in the arterial lumen. It was thought that following this the circulation should be adequate.

Subsequent course. During the night the patient was quite well, but on the following day she became slightly drowsy; the lethargy steadily deepened and at the same time a definite left-sided facial weakness was noted. Under local anesthesia the band was removed and immediately the pulse returned in the exposed artery above the band, and promptly thereafter function in the left side of the body improved; in another 24 hours it was quite normal. The drowsiness also became less marked. The patient appeared to be essentially as she had been before the operation. Immediately after the band had been placed and during the first night, the murmur that had been heard over the right side of the head was abolished, but upon removal of the band it was heard as before. It is also worthy of note that the thrill in the loop of the cervical carotid artery, which was exposed at the operation, again returned when the band was removed.

On the following day—that is, 24 hours after the band was removed—the *left eyeball became edematous and the murmur could now be heard over the left side of the head.* The patient's general condition was good; she was quite responsive, and had normal power in the left leg and arm. There was no facial weakness and no Babinski. On the following day, June 14th, the left eye was definitely more prominent; there was ptosis of the upper lid and almost complete paralysis of the third nerve, all of which came on overnight. The edema of the lids was further increased, but there was no definite pulsation in either eye. There was now definitely bilateral exophthalmos. The exophthalmos of the second side, therefore, developed 25 days after the accident. The extraocular movements were now equally limited on the two sides, there being almost complete bilateral ophthalmoplegia.

On June 22, 1938, the wound was opened and a partially constricting band of fascia lata again placed around the vessel, care being taken not to constrict the vessel too severely. It was hoped that new tissue, building up around the band, would eventually induce occlusion. A good pulse remained above the band. The bruit was reduced but was distinctly present. On the following day the bruit had returned to the preoperative level.

On July 7th—27 days after admission—the vision had rapidly declined in both eyes to R.E. 6/100, and L.E. 6/40 (it was 6/40 right and 6/12 left on admission). The visual fields had not changed. The exophthalmometer readings were 25 left and 24 right (12 left and 18 right on admission). There was then slight blurring of both nerve heads, but no hemorrhages; the retinal veins were full and quite tortuous (examinations were made by Dr. Alan Woods).

The patient's condition remained practically unchanged until July 13th, 21 days following the replacement of the fascial band, and one month following the first application of the band. Her blood pressure was then 150/100, essentially the same as on admission. From that time on the patient began to decline rapidly; she became progressively more drowsy, but there was no return of the weakness on the left side of the body.

On July 15, 1938, under local anesthesia, the right internal carotid artery was totally ligated above the band with a double suture of medium silk. There was no immediate effect following this operation. The left side was not weak, but during the following two days the drowsiness that had already become apparent and progressive before the operation steadily deepened, and the patient died on July 18, 1938. Fever first appeared five days before her death and gradually increased until the end. Three

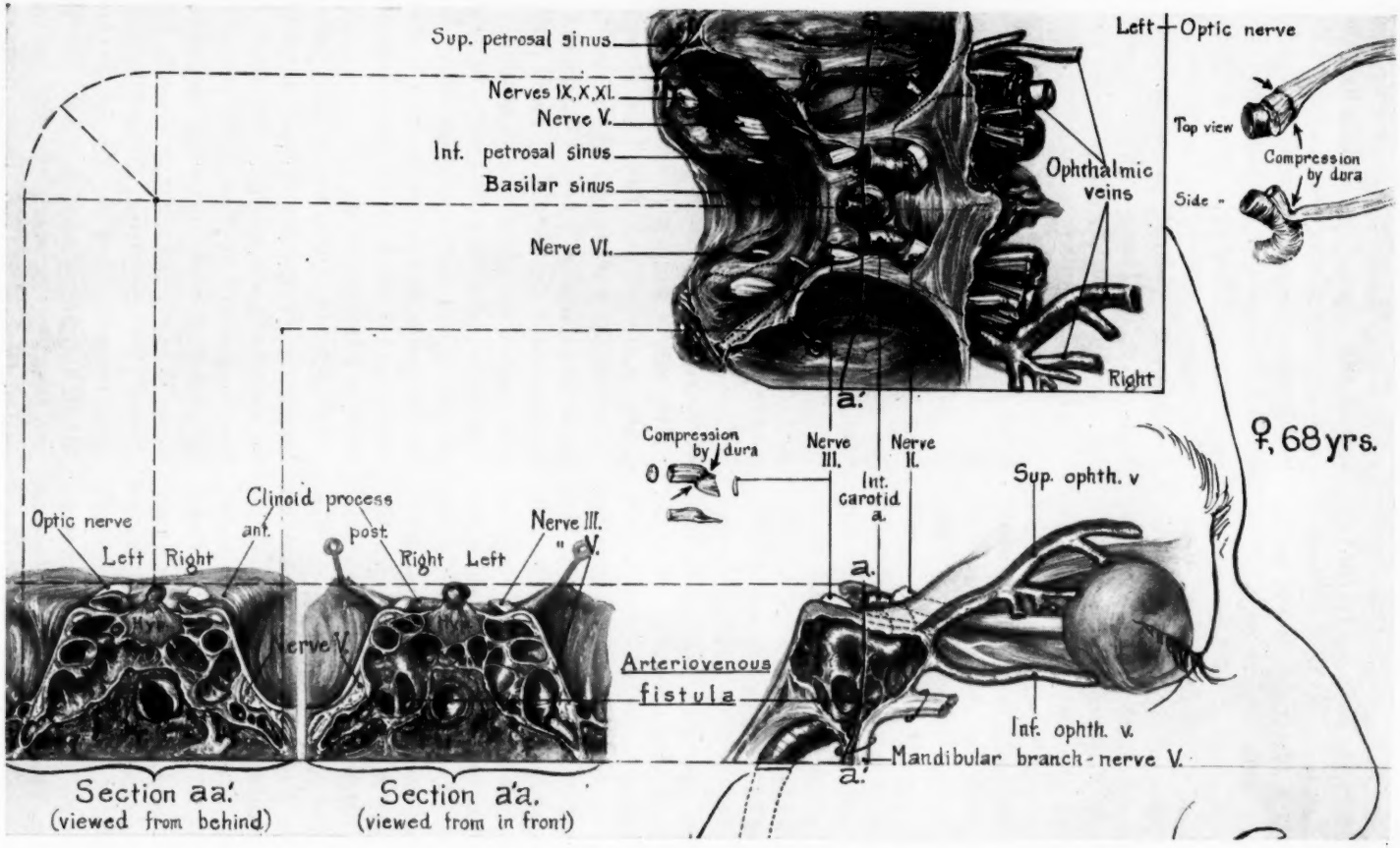

Fig. 6 (Dandy and Follis). Drawing of specimen removed at autopsy from case 2. A frontal section "a. a'." has been made through the center of the hypophysis so as to expose the cavernous sinus and internal carotid vessels. The arteriovenous fistula is shown in the lateral reconstruction and in section "a'a."

days before her death there was early papilledema of both discs, and numerous small hemorrhages were seen scattered throughout both fundi.

PATHOLOGICAL REPORT (Autopsy No. 15959).

The autopsy was performed one and a half hours after death. Permission was restricted to an examination of the head neck, and thorax. The aorta showed only moderate arteriosclerosis. The right lung was normal. There was some fibrinous exudate over the surface of the left lung and scattered areas of lobular pneumonia. This was verified by microscopic study.

Arteriovenous fistula and related structures (fig. 6). The sphenoid bone together with the anterior portion of the occipital bone was removed *in toto*. A frontal section was made (a.a.') directly through the hypophyseal stalk in order to show the cavernous sinuses and the carotid arteries. A few millimeters after it passed through the foramen lacerum, the right carotid artery presented an oval opening (9 by 7 mm.) on the superior lateral wall. The edges of the opening were smooth and regular. The artery beyond was smaller than the left internal carotid. This difference in size was found within both the cavernous sinus and the cranial chamber, where this vessel was about two thirds as large as the opposite artery. The left internal carotid showed no lesion. Microscopic study of the wall of both intracranial portions of the carotid arteries revealed no change. A section through the fistula in the right carotid showed elastic tissue extending almost to the margin of the opening in normal fashion. At this point the elastic fibers became frayed and ceased entirely, and beyond this for a short distance the margin of the opening was made up of connective-tissue cells with very little collagen present (fig. 7).

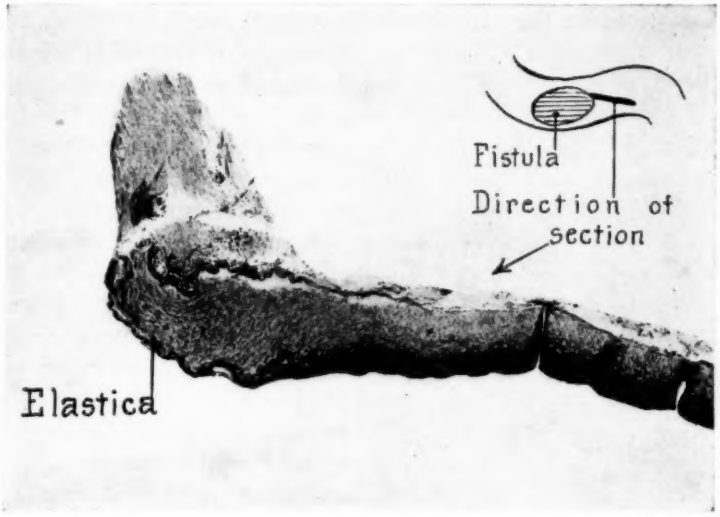

Fig. 7 (Dandy and Follis). Photomicrograph of wall of the internal carotid artery at the edge of the arterio-venous communication to show disappearance of elastica.

Cavernous sinuses. Both cavernous sinuses were approximately the same size, each being at least twice the normal size. When the base of the skull was viewed from above one could see a distinct

though not marked bulge in the region of the cavernous sinuses. This bulge would doubtless have been much increased during life when filled with blood. There was wide communication between the two cavernous sinuses through a *single* large intercavernous sinus, the width of which was 1.2 cm. at the maximum and 5 mm. at the narrowest part. This extensive intercavernous sinus (circular) extended about 3 mm. posterior to the hypophysis

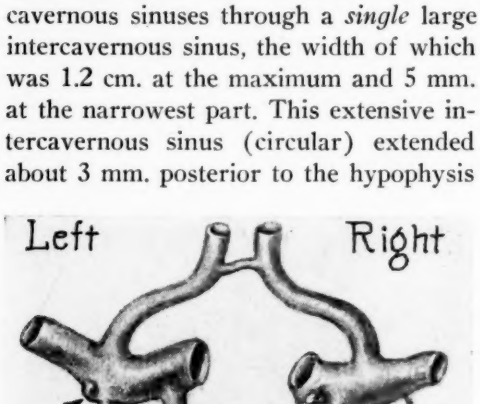

Fig. 8 (Dandy and Follis). Circle of Willis, case 2. Note small right posterior communicating branch as well as inadequate communicating artery.

and ended about 3 mm. posterior to the anterior border of the hypophysis. The pituitary body was elevated and compressed by it from beneath, and laterally was also compressed by the symmetrically enlarged cavernous sinuses. Trabeculae were still present in both cavernous sinuses but were more in evidence on the left. The enlargement of the cavernous sinuses had pushed both internal carotid arteries laterally, had markedly compressed both oculomotor nerves, and had elevated both optic nerves at the optic foramina to such a degree that a decided angulation resulted (fig. 6). Both Gasserian ganglia were elevated and flattened by the lateral extensions of the enlarged cavernous sinuses.

Venous tributaries. On both sides the superior and inferior ophthalmic veins entered the cavernous sinuses separately; the superior branches were about twice the normal size, and the inferior branches slightly less. The inferior petrosal sinuses were somewhat enlarged where they arose from the cavernous sinuses. Each measured about 1.2 cm. in diameter and retained this dimension for a distance of 2 cm., when they abruptly diminished to a diameter of 4 mm. The basilar sinus measured 1 cm. in width and was fairly uniformly dilated from side to side. It was at least 5 mm. in depth (fig. 6).

A superior petrosal sinus was present on each side, but showed no definite dilatation. Although the cavernous sinus was actually much enlarged under the mandibular branch of the trigeminus as far as the foramen ovale, one could detect no enlargement of the connections with the pterygoid plexus.

The sphenoparietal sinuses were present on both sides but barely admitted a probe.

Thrombi. There were no thrombi in any part of the arterial or venous components of the arteriovenous lesion nor of the arteries or veins in the neck.

Anomalies along the circle of Willis (fig. 8). At three points there were curious out-pouchings of the arterial wall and at these places the wall became very thin (potential aneurysms). On the posterior wall of the right internal carotid artery was a small bulging area (4 by 4 mm.) of marked thinning—so thin that a rupture seemed imminent, but the wall was intact. On the left carotid where the choroidal artery began there was a similar thin pouch like a tiny aneurysm; it, too, was unruptured. On the basilar artery (left side) was a similar thinning, at the point where the superior cerebellar

artery began. The anterior communicating artery was tiny, not more than 1 mm. in diameter. The right posterior communicating artery was not larger. It was in marked contrast to the unusually large posterior communicating artery on the left side. A section through one of the out-pouchings on the circle of Willis showed a greatly thinned wall, with loss of elastic tissue.

Brain. Externally the brain showed nothing except a few small hemorrhages in several convolutions on the orbital surface of the right frontal lobe. There was very slight sclerosis of the vessels at the base. The right carotid was about two thirds the diameter of the left carotid. The basilar and vertebral arteries were normal.

Infarct within the brain. On section through the brain there was seen an infarct with a rather curious distribution. On the right side beginning in the anterior part of the right frontal lobe a little anterior to the internal capsule the white matter showed some old softening. As one proceeded posteriorly, the white matter was found to be soft until the anterior portion of the globus pallidus was reached. Here the tissue was likewise soft, and there was an old cavity between the globus pallidus and the internal capsule. All had the appearance of an old lesion. In the cortex of the island of Reil on the left side there were small hemorrhages with some softening. Proceeding posteriorly, there was found in the midline a fresher lesion consisting of hemorrhage and necrosis of the mesencephalic tissues; the mesial margins of both cerebral peduncles were involved at this level. Still farther back the lesion continued. In the anterior part of the pons the tissue in the midline beneath the aqueduct was softened, and there was a hemorrhage in the inferior half of the left side of the pons. Farther back in the pons at its posterior extremity, the whole inferior half was necrotic and there was a triangular area of necrosis and hemorrhage in the tissue beneath the fourth ventricle. Microscopically, at the site of the gross lesions described above, there were areas of hemorrhage and necrosis. At many such points all the ganglion and glial cells were necrotic, and the tissue was swollen and vacuolated. No completely occluded vessels could be made out in numerous sections. The areas of hemorrhage and necrosis were accompanied by another interesting change. Especially marked in the globus pallidus, though to a lesser extent in the thalamus, cerebellum, and even the cerebral cortex, were many small arteries with calcified walls. Even out in the tissues there were numerous granules which took a dark blue stain with hematoxylin, and some of these had the outlines of nerve cells. Some of the vessels were narrowed by the deposition of this material in their walls but none, as stated above, could be found which were completely occluded. There was just as much of this material on the right as on the left side.

Eyes. Microscopic study of the posterior segments of both eyes revealed very little atrophy of the optic nerve. There were a few small hemorrhages in the retina as well as edema of the choroid. The vessels in the latter seemed prominent.

Summary of vascular findings at and near the carotid–cavernous-sinus arteriovenous aneurysms

Case 1. (1) Two separate fistulae of approximately the same size and roughly circular were found between the left internal carotid artery and the cavernous sinus. Each measured 4.7 mm. in the two directions. The edges were smooth.

(2) The first fistula was in the anterior wall of an arterial dilatation within the

cavernous sinus—doubtless a preëxisting arterial aneurysm. The second fistula was on the superior wall of the sac and was 1 cm. distant from the first fistula.

(3) The cavernous sinus was dilated and measured 2.5 cm. vertically, 2.5 cm. in width, and 1.5 in length. The contralateral cavernous sinus was about one third as large.

(4) A mesial pouch of the sinus dislocated the hypophysis to the opposite side.

(5) A second mesial pouch of the sinus projected intracranially and compressed the oculomotor nerve.

(6) The walls of the cavernous sinus were thickened (in places 2 to 3 mm.), and in one place there was calcification.

(7) The walls of the ethmoid cells were eroded and the mucosa was displaced.

(8) The two cavernous sinuses were connected directly by a 2-mm. opening lying between the two dilated pouches of the cavernous sinuses. Indirectly they communicated through the basilar sinus by a 2-mm. opening that was continuous with the inferior petrosal sinuses.

(9) The inferior and superior petrosal sinuses ended laterally in blind pouches and did not connect with the jugular system.

(10) The superior ophthalmic vein on the *left* was completely occluded; the inferior was not present.

The superior ophthalmic vein on the *right* was enormous, elongated, and tortuous.

(11) The wall of the internal carotid on the affected side was thickened before it entered the aneurysm.

(12) A well-organized gray thrombus measuring 1.7 by 1.2 cm. filled the inferior portion of the left cavernous sinus. It lay 2 or 3 mm. anterior to fistula no. 1, hence did not reach the fistula. The left ophthalmic vein was totally obliterated by an older thrombus. There was no connection between this thrombus and that of the cavernous sinus. There was a thrombus in the carotid artery after it had passed through the foramen lacerum.

(13) At the junction of the left posterior communicating and posterior cerebral arteries was a small sacculated aneurysm measuring 1 cm. by 8 mm.

Case 2. (1) A single fistula (9 by 7 mm.) was found on the posterolateral wall of the carotid artery within the cavernous sinus. The edges were smooth and regular.

(2) Both cavernous sinuses were enlarged to at least twice the normal size.

(3) There was a wide communication between the two cavernous sinuses by a single intercavernous sinus that measured 1.2 cm. at the maximum and 0.5 cm. at the minimum diameter. Is was just posterior to and beneath the hypophysis, which was elevated and compressed.

(4) Both internal carotid arteries were dislocated laterally.

(5) Both Gasserian ganglia were elevated and compressed by lateral extensions of the cavernous sinuses.

(6) The superior ophthalmic veins on both sides were about twice the normal size.

(7) Both inferior petrosal sinuses were somewhat enlarged. The superior petrosal sinuses showed no definite dilatation.

(8) The internal carotid artery was distinctly smaller beyond the fistula and its size not appreciably changed below it.

(9) The elastic coat of the carotid artery was lost at the fistula.

(10) There were no thrombi in the cavernous sinus nor in the carotid artery.

(11) The anterior communicating artery was small; the right posterior communicating artery, tiny. These probably were not sufficient to maintain a collateral circulation.

Unusual clinical features

The clinical aspects of case 1 are of interest because of the absence of exophthalmos and pulsation on the side of the fistula, and the marked proptosis with pulsation on the contralateral side. However, the complete third-nerve palsy could leave no doubt of the marked involvement of this side also; that is, bilateral involvement of the cavernous sinuses. It could only be inferred that total thrombosis of the ophthalmic vein was present and precluded pulsating exophthalmos on the side of the fistula. This was confirmed by the necropsy specimen. Two other cases of this character have been described (Nuel and Pincus). In Nuel's case thrombosis of the ophthalmic vein was demonstrated at necropsy. Pincus probably rightly inferred that destruction of the sympathetics was responsible for an actual exophthalmos in his case, but one cannot avoid the conclusion that the ophthalmic vein was also thrombosed. His patient did not come to necropsy. In Reif's case there was greater exophthalmos on the contralateral than on the affected side. This could be due only to some factor, such as a partial venous thrombus, that made the dilated venous bed smaller.

In our case 1 there is the added information that on a previous admission to the Johns Hopkins Hospital exophthalmos of low grade was present on *both* sides and that it was equal on the two sides. If this observation is correct, it would mean that the thrombosis was of later development and had allowed the exophthalmos to recede. The thrombus, as disclosed at post-mortem examination, had stopped short of the fistula and had, therefore, merely changed the expression of the lesion.

The choice of sides upon which to ligate the internal carotid artery is dependent upon more fundamental considerations—that is, the side upon which the murmur is altered, both subjectively and objectively, by compression of the carotid artery in the neck. One cannot overestimate the importance of this test in arriving at the side of the lesion. Had the wrong side been chosen by the greater exophthalmos on the *right*, it is hardly possible that any benefit would have resulted and subsequent closure of the *left* internal carotid would have been out of question.

Another case upon which the importance of this test rested was reported by Dandy a few years ago. In a case with equal and symmetrical bilateral pulsating exophthalmos, the side of the fistula was disclosed in this way and the patient responded promptly to partial occlusion of the artery on that side.

The importance of the compression test as a preliminary to treatment also cannot be overemphasized. If compression of the carotid in the neck cannot be tolerated for a 5- or 10-minute period total occlusion of the internal carotid will surely cause disastrous results to the brain; only a partial occlusion is then in order. Two or three weeks hence the total occlusion will be safe. Matas has long emphasized the importance of this test, which should doubtless be known as the "Matas test."

There were several noteworthy features in case 2. The late appearance of the exophthalmos on the second side was 24 days after the accident, whereas the exophthalmos appeared immediately after the accident on the other side. This came suddenly four days after the patient's admission to the hospital. Sattler's beautiful study of this lesion has shown that, in the bilateral form, the exophthalmos on the two sides develops synchronously in one third of the cases and that in the remaining cases the time of appearance on the second side varies from a day to

15 months. In 19 such cases the second side developed exophthalmos in 1 to 7 days in five cases; in from 1 to 7 weeks in three; and in from 2 to 15 weeks in four. One would suppose that the arterial pressure within the small venous channels connecting the two cavernous sinuses gradually caused them to dilate. In those cases in which exophthalmos appears at once, the venous connections are already well developed; in the remaining cases the connections are only potential, or at least inadequate until the intravascular pressure causes their enlargement.

The rapid appearance of paralysis of the functions of the third nerve and of vision on the side of the first exophthalmos is also interesting. With the appearance of exophthalmos on the second side—overnight—there was an equally immediate and complete paralysis of the corresponding third nerve.

The loss of vision appears to be due to pressure upon the optic nerve through the intervening carotid artery, which was pushed forward by the enlarged cavernous sinus. The upper right inset (fig. 6) shows the kink induced by this pressure; doubtless the effect would be even greater during life. In case 1 the same effect in exaggerated form was observed and commented upon at the operation. It does not seem possible that vision could be lost by the exophthalmos *per se* because orbital tumors growing with equal rapidity spare vision unless the optic nerve is directly attacked. And since there was no papilledema until the end stages, vision could not be lost from that effect. Moreover, the third nerve is similarly bent at the fixed point in the dura (central inset, fig. 6) from the underlying pressure in the enlarged cavernous sinus, and the sudden loss of function of this nerve, with the appearance of the exophthalmos on the other side, could have no other explanation. The same explanation doubtless holds for the sixth nerve also. In case 1 there was a well-defined round herniation of the cavernous sinus beneath the third nerve, which was markedly flattened by it, as if by a tumor.

The frequency of extraocular palsies with pulsating exophthalmos has long been recognized. Keller (1898) found an immobile eye in 23 percent and partial loss of functon in an additional 37 percent of 92 cases. In 128 cases of extraocular palsies Sattler found that the third nerve was affected in 28 percent, the fourth nerve in 10 percent, and the abducens in 62 percent.

Pathological findings. One of these aneurysms was purely traumatic, the other probably arose from rupture of a preëxisting aneurysm. Whether trauma played any role in the rupture cannot be established.

In one of these specimens there was a single opening (9 by 7 mm.), in the other there were two openings about 1 cm. apart, each measuring 7 by 4 mm. Double fistulae have been reported by Usher, Nuel, and Seyfarth, and three distinct openings by Schlaefke. Reclus reported a case in which there was a single opening in each carotid artery.

The development of arteriovenous fistulae from preëxisting carotid aneurysms has been demonstrated in post-mortem examinations by Morax and Ducamp, Hirschfeld, Karplus, Jack, Baron, and Nunnelly. In his first excellent description of a pathological specimen—the most perfectly described specimen to date—Delens stated that Vieussens and Morgagni had described dilatations of the carotid within the cavernous sinus and that Charcot had disclosed miliary aneurysms of the brain with which he thought the intracavernous arterial dilatations were probably analogous. Following carotid injections of fluids under pressure in cadavers, Charcot also found that ruptures always occurred in this region, thereby disclosing the inherent weakness of the carotid in its

intracavernous portion. In his search through the literature Charcot found a case in which a small aneurysm had developed in the carotid canal from a spicule of bone. Many unruptured arterial aneurysms of the internal carotid within the cavernous sinus and of varying size up to very large masses have since been reported. However, it is highly improbable that the large ones can form an arteriovenous fistula because they have obliterated the cavernous sinus and, therefore, eliminated the venous receptacle which is necessary for the development of an arteriovenous aneurysm.

That the intracavernous portion of the carotid is perhaps the weakest portion of the carotid in keeping with Charcot's experiment is beginning to be realized. In case 1 of this report there is a large calcified plaque in this portion of the carotid; and in a case reported by Dandy (Zentralbl. fr. Neurochir., 1937) there was diffuse calcification of the media and erosion of the intima from which a propagating thrombus developed in an otherwise healthy man of 37. In yet another of our (W. E. D.) cases there were large bilateral aneurysms of the carotid arteries arising within the carotid canal. From clinical experiences we know that there are also frequent instances in which a sudden cerebral thrombosis has unquestionably occurred with partial loss of cerebral functions and in which the ventriculograms show such a diffuse unilateral cerebral atrophy, involving the entire hemisphere, that only a carotid occlusion could be responsible for the cerebral changes. These cases do not come to necropsy, so that the proof of such a lesion is lacking. In two recent cases of this kind the carotid pulsation in the neck appeared to be less on the affected side, and total occlusion of this vessel in the neck produced no cerebral changes on the affected side, but caused swooning quickly when the other side that was presumed to be unaffected was occluded.

The *size* of the opening in the carotid in our two cases was 9.7 mm. (single fistula) and 4 by 7 mm. in each of the two fistulae (double fistulae). All of these are slightly larger than the measurements recorded in the literature. The fistula in Nélaton's specimen (first reported by Henry, 1856) was 6 mm. long (it contained a splinter of bone); in Nélaton's second case, reported by Delens, the fistula was nearly as long and 2 mm. wide; in that of Cantonnet and Cerise 3 mm., in Jack's 3.25 mm., and in Karplus's 3 mm. In Stuelp's case it was the size of a pea and in Sloman's the size of a hempseed.

The *location* of the fistula, particularly with reference to the side of the artery involved, is noted in several reports. In our first case one opening is on the anterior and inferior surface of the carotid (aneurysm), the other on the superior surface of the artery. In the second case the opening is on the superior and lateral surface of the artery. The cases reported in the literature show the openings to be in almost any position—on the superior wall in Delen's case, on the outer wall in three cases (Schlaefke, Stuelp, and Gibson), and on the mesial surface in five (Usher, Cantonnet and Cerise, Jack, Nuel, Seyfarth). The position of the fistula appears to have no bearing upon the development of unilateral or bilateral pulsating exophthalmos. Except for Sloman's case, in which the site of the fistula is not detailed, our cases are the only bilateral ones in which the location of the fistula is described. C. H. Sattler advanced the view that the position of the fistula might be responsible for the development of the unilateral or bilateral form—that if the fistula lay well anteriorly, unilateral exophthalmos would develop, and if the opening was situated more posteriorly, bilateral involvement

would occur. We, too, had entertained this view but are more dubious about it now.

The degree of exophthalmos does not appear to be dependent upon the size of the fistula alone. In our second case the fistula was larger than either of the two fistulae in the first case, but smaller than the two combined, but the degree of exophthalmos was very much less. Moreover, although the opening in the second case was larger than in any of the cases reported in the literature, the grade of exophthalmos was among the lowest. It appears more probable that the degree of exophthalmos is dependent upon the varying amount of venous collateral that can take the burden of the ophthalmic veins. This collateral would be principally the basilar sinus and the superior and inferior petrosals. The *changes in the venous system* in these two cases are, on the whole, not surprising. In both cases the cavernous sinuses are bilaterally much enlarged, and there is free communication between the two sides by an intercavernous sinus and by a larger basilar sinus. In case 1 the intercavernous connection is hour-glass-shaped with a minimum diameter of 2 mm., but in case 2 the communication was very wide and not restricted in its course.

The relatively low grade of exophthalmos and the absence of large veins on the forehead in case 2, and in other cases from the literature, are, of course, dependent upon the size of the ophthalmic veins. In case 1 the right ophthalmic vein was enormous. In case 2 these veins were enlarged, but only to a moderate degree. Time unquestionably accounts for much of this difference, but in many other cases the exophthalmos had developed to an extraordinary degree in a very short time. One can only infer that the resistance of the venous walls in the orbit differs with the individual, or perhaps the stricture at the sphenoidal fissure is less distensible. In case 1 the size of the ophthalmic vein was much smaller at the sphenoidal fissure and progressively enlarged distal thereto. Then, too, the presence or absence of the varying degree of venous collateral from the cavernous sinus must make a difference in the volume of the load that is thrust upon the ophthalmic veins. For example, in case 1 both the superior and inferior petrosal sinuses were absent, only pouches remaining at the basilar sinus; all the blood, therefore, had to pass into the ophthalmic veins. In case 2 both superior and inferior petrosal sinuses were present, so that part of the blood was probably diverted to the internal jugular veins.

It is particularly interesting that the left ophthalmic vein (on the side of the fistula) was obliterated by an old thrombus that extended into the anterior part of the cavernous sinus. This finding was predicted by the absence of exophthalmos. Its absence thrust an additional large burden upon the contralateral ophthalmic vein. Had this thrombus continued backward, as happened in some cases, and included the fistula, a spontaneous cure would have resulted. This finding also demonstrates the fact that the pulsating exophthalmos may be cured without curing the fistula. The ultimate test of a cure is the disappearance of the murmur.

Another small mural thrombus only partially occluded the internal carotid as it entered the base of the skull. Both this thrombus and that in the ophthalmic vein show that the propagation or non-propagation of a thrombus is a matter of chance.

In both cases the hypophysis was displaced upward and forward by the enlarged intercavernous sinus. Whether this would interfere with hypophyseal functions would doubtless depend upon how much destruction of the hypophysis

occurred with time. This structure was well preserved in both cases. Both patients were beyond the age when the symptoms of pituitary dysfunction would be obvious.

In case 2 there was no thrombus at any point in either the arterial or venous system contiguous to the fistula.

The internal carotid arteries within the cavernous sinuses were closely applied to the sphenoid bone and hypophysis in case 1 (except anteriorly on the left where an interposed pouch of the cavernous sinus dislocated it laterally), but were displaced laterally in case 2. The internal carotid artery was considerably smaller distal to the fistula in both cases than on the contralateral side—probably due to the diversion of blood through the fistula.

In case 1 there were two small aneurysms of the circle of Willis—one in the right anterior cerebral artery, the other at the junction of the left posterior communicating and posterior cerebral arteries. Doubtless the aneurysm of the carotid with rupture into an arteriovenous fistula was a similar one of congenital origin. The frequency of such aneurysms is now well recognized.

Bibliography

Baron. Report at anatomical society by M. Bell, secretary. Bull. de la Soc. Anat., Paris, 1835, p. 178.

Cantonnet and Cérise, L. Anévrisme artério-veineux spontane de l'orbite. Arch. d'Opht., 1907, v. 27, p. 34.

Dandy, W. E. The treatment of carotid-cavernous aneurysms. Ann. Surg., 1935, v. 102, p. 916.

——. Carotid-cavernous aneurysms (pulsating exophthalmos). Zentralbl. f. Neurochir., 1937, 2 Jahrgang, no. 2.

Delens, E. De la communication de la carotide interne et du sinus caverneux. Thèse de Paris, 1870.

Henry, A. A. Considerations sur l'aneurysms artério-veineux. Thèse de Paris, 1856.

Hirschfeld, L. Epanchement de sang dans le sinus caverneux du côté gauche; diagnostique pendant la vie. Gaz. des Hosp., 1859, v. 32, p. 57.

Jack, E. E. A case of pulsating exophthalmos—Ligation of the common carotid artery—Death. Trans. Amer. Ophth. Soc., 1907, v. 11, p. 439.

Karplus, P. Anatomical preparation demonstration before Gesellschaft der Aerzte in Wien. Wien. med. Woch., 1900, v. 13, p. 357.

Keller, E. Beiträge zur Kasuistik des Exophthalmus pulsans. Inaug. Dissert., Zürich, 1898.

Matas, R. Surgery of the vascular system. Keen's Surgery, 1909, v. 5, chap. 70, p. 320.

——. Occlusion of large surgical arteries with removable metallic bands to test the efficiency of the collateral circulation. Jour. Amer. Med. Assoc., 1911, v. 56, p. 233.

Morax et Ducamp. Anévrisme artériosoveineux non traumatique consécutif à la rupture d'une poche aneurysmale de la carotide interne dans le sinus caverneux. Ann. d'Ocul., Juin, 1916. Klin. M. f. Augenh., 1916, v. 2, p. 443.

Nélaton. Sur l'anéurisme artérioveineux. Lancet (Holmes lecture) 1873, v. 2, p. 142. Also see Thèse d'Henry, 1857.

Nuel, J. P. Externe Oculomotoriusparese als einziges Symptom einer traumatischen Verbindung der Carotis interna und der Sinus cavernosus. Centralbl. f. Ophth., 1902, p. 43.

Nunnelly, T. Vascular protrusion of the eyeball. Lancet, 1864 (Dec.).

Pincus, F. Spontanheilung eines traumatischen pulsierenden Exophthalmus. Zeit. f. Augenh., 1907, v. 18, p. 33.

Reclus, P. Sur une observation d'exophtalmos pulsatile. Gaz. des Hospit., 1908, p. 1001.

Reif, E. Ein Fall von doppelseitigen hauptsächlich gekreuzten pulsierenden Exophthalmus. Beit. z. Augenh., 1899, no. 38, p. 25.

Sattler, C. H. Beitrag zur Kenntnis des pulsierenden Exophthalmus. Zeit f. Augenh., 1920.

Schlaefke, W. Die Aetiologie des pulsierenden Exophthalmus. v. Graefe's Archiv. f. Ophth., 1879, v. 25, p. 112.

Seyfarth, C. Arteriovenöse Aneurysmen der Carotis interna mit dem Sinus cavernosus und Exophthalmus pulsans. Münch. Med. Woch., 1920, v. 67, p. 1092.

Sloman, H. C. Bidrag til Laeren om d. puls. Exophth. Dissert. Kopenhagen, 1898.

Usher, C. H. Notes on cases of pulsating exophthalmos. Ophth. Rev., 1904, v. 23, p. 315.

ORBITAL TUMORS AND THEIR SURGICAL TREATMENT*

PART I

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This paper will be published in two installments in successive issues of the Journal. This installment includes a discussion of exophthalmos from tumor and tumorlike lesions primary in the orbit. The next installment will include exophthalmos from lesions adjacent to the orbit and systemic and distal lesions, together with a discussion of the indicated surgical procedures.

The problem of determining the cause of a unilateral exophthalmos is one of the most interesting with which the ophthalmologist has to deal and is frequently a diagnostic challenge requiring every available aid. In order to gain a better understanding of the subject the 174 consecutive cases of unilateral exophthalmos caused by tumors and tumorlike lesions encountered at the Institute of Ophthalmology and the Memorial Hospital for the Treatment of Cancer and Allied Diseases during the past seven years have been analyzed.

This series includes only those cases in which the diagnosis was verified by biopsy or other surgical measures. Excluded were cases of nonsurgical exophthalmos arising from exophthalmic goiter, arteriovenous aneurysm, sinus mucocele, cavernous-sinus thrombosis, oxycephaly, and aneurysm of the ophthalmic artery. Thus, for all practical purposes, the series consists of cases of tumors and tumorlike lesions characteristically the most difficult to diagnose. Included are 21 lesions which had not produced exophthalmos for one reason or another but which were considered potentially capable of doing so; for example, of 10 dermoid and epidermoid cysts, 6 produced no exophthalmos because of their forward position in the orbit.

The study was undertaken with particular regard to the following factors:

(1) The distinguishing characteristics of the different types of orbital tumors and allied conditions important in differential diagnosis.

(2) The incidence of the various lesions, a knowledge of which is important in diagnosis and cannot be obtained from the isolated case reports appearing in the literature, consecutive cases being indispensable.

(3) The types of treatment indicated, especially from the surgical standpoint.

(4) The prognosis. This, too, cannot be determined from the literature as the cases are almost invariably reported a short time after they have been observed and treated. An effort has been made in this study to follow cases long enough to determine their final outcome with some degree of certainty.

There are two conditions which simulate exophthalmos and these should be ruled out as an initial step in differential diagnosis. The first is a unilateral myopia of from 25 to 30 diopters; the second, early hyperthyroidism (of which the patient may be unaware), in which the earliest eye manifestation is a retraction of the upper lid due to stimulation of the smooth muscle of Müller; when this is unilateral an exophthalmos appears to exist and can be ruled out only by means of an exophthalmometer.

Cases of slight exophthalmos resulting from the paralysis of one or more of the

* From The Institute of Ophthalmology of The Presbyterian Hospital and Memorial Hospital for the Treatment of Cancer and Allied Diseases.

recti muscles, or from a rectus muscle tenotomized or greatly recessed at the time of a squint operation, should also be ruled out. These conditions may so reduce the retractive influence of the muscles on the eyeball that a proptosis of from two to three millimeters is produced.

It is interesting to note in this connection that if an extraocular muscle is paralyzed in the presence of other factors which tend to produce exophthalmos, the protrusion of the eye is greater than that which arises from the one single factor: A 5-year-old girl with complete paralysis of the left external rectus had an exophthalmos of 5 mm. The primary lesion proved to be an intracranial hematoma which pushed the lateral wall of the orbit inward. This increased the intraorbital pressure and gave rise to an exophthalmos which, in the presence of the paralyzed external rectus muscle, was considerably more extensive than it would otherwise have been.

Sources of unilateral exophthalmos

A unilateral exophthalmos produced by a tumor may arise from one of three sources: (1) a lesion primary in the orbit (109 cases in this series); (2) a lesion in the region contiguous to the orbit (51 cases); or (3) a systemic or distal lesion (14 cases). In this study etiologic classification was made according to this grouping and the causal lesions are listed in the order of their frequency. From the fact that the series was compiled in part from cases seen at the Memorial Hospital for the Treatment of Cancer and Allied Diseases, the proportion recorded here as arising from extraorbital and systemic or distal lesions is probably unduly high.

Exophthalmos from lesions primary in the orbit

Hemangioma (5 with no exophthalmos)		25
Pseudotumor (2 with no exophthalmos)		18
*Meningioma		13
Dermoid and epidermoid cysts (6 with no exophthalmos		10
Sarcoma		
Lymphosarcoma	5	
Rhabdomyosarcoma	2	
Osteogenic sarcoma	1	
Fibrosarcoma	1	
Myosarcoma	1	10
Neurogenic tumors		
Neurofibroma (4 with no exophthalmos)	8	
Glioma of optic nerve	1	
Neurilemmoma (neurinoma, Schwannoma)	1	10
Mixed tumor of lacrimal gland		9
Lymphoma		3
Hematoma		3
Osteoma		1
Xanthoma		1
Fibroma (from tendon sheath)		1
Osteitis fibrosa cystica		1
Lipoma (no exophthalmos)		1
Lymphangioma (producible exophthalmos)		1
Zenker's waxy degeneration of rectus muscle		1
Tuberculous dacryoadenitis		1
Total		109

* Not all of these cases were primary in the orbit, but, due to the difficulty of dividing them accurately, it seemed best to discuss them as a group.

Hemangioma. The most frequent cause of proptosis due to a lesion primary in the orbit is hemangioma. The following types are recognized: (1) capillary; (2) cavernous; (3) angioblastic or hypertrophic; and (4) racemose or cirsoid. The angioblastic type is quite cirrhous, being composed of a solid mass of endothelial cells with no patent vessels or a minimum of extremely small channels. The lumina became obliterated by rapid proliferation of embryonic endothelium. One of the group reported here belonged to this type and it was difficult to diagnose not only clinically but even microscopically. The racemose type is composed of a pulsating mass of dilated, thickened, tortuous vessels and proliferating capillaries. They occur in adults and have a relatively sud-

den onset. They probably represent an ordinary hemangioma that has established a communication with a surrounding normal artery or arteriole. After the arteriovenous communication enlarges, the tumor becomes locally destructive by reason of constant arterial pulsation. These tumors may erode surrounding bone, thereby invading vital structures, and they may also lead to fatal hemorrhage.

A characteristic of hemangiomas, except those of the racemose type, is that they do not show progressive unlimited growth but tend to reach a size and then become stationary. As pointed out by Watson and McCarthy, the tumor-growth generally stops with full body-growth. We should bear this in mind before deciding on too radical and destructive surgery in young individuals. Excepting again the racemose type, the tumors do not invade nor communicate with surrounding normal vessels. There is only one afferent and one efferent vessel. The occasional spontaneous regression results from accidental thrombotic occlusion of this very tenuous blood supply. Watson and McCarthy have reported on 1,001 hemangiomas located at various sites over the entire body. Eighty-five percent had manifested themselves before the end of the first year. Sixty-five percent were in females, and this fact, together with the fact that a hemangioma may start or increase rapidly in size with the onset of the menses, or at the beginning of a pregnancy, indicates a possible relation to the female sex hormone. The head and neck region is less than one seventh of the total body surface but more than half (56 percent) of Watson's and McCarthy's cases occurred in this region.

In our series of orbital hemangiomas, the patients ranged in age from 4 months to 55 years, an average of 25 years.

Two noteworthy characteristics of this type of tumor in the orbit are: (1) its failure to affect the motility of the eye, and (2) variations in its size and thus in the extent of the exophthalmos. These variations may be spontaneous, due to a variable stasis in the venous circulation, or they may be produced by any maneuver which increases the congestion in the jugular area, such as compression of the vein, bending of the head, crying, coughing, and the like.

Sometimes the hemangiomatous nature of the lesion is revealed by an extension of the growth sufficiently far forward to be seen subconjunctivally or subcutaneously. In rare instances there may be an associated nonelevated "naevus flammeus" or "port-wine" type of lesion on the lids or face. Although the skin lesion is present from birth, it is only later in life that an exophthalmos occurs from the growth of a hemangioma in the orbit, or that a hemangioma may manifest itself in the choroid where it often produces glaucoma.

Some types of the tumor are radiosensitive, and Watson and McCarthy have pointed out that this radio-sensitivity varies in inverse proportion to the age of the patient. The response to other methods of treatment, such as sodium-morrhuate injection and carbon-dioxide snow, also seems better the younger the patient.

The orbital hemangiomas are also usually encapsulated and therefore lend themselves well to local excision.

The injection of 5-percent sodium-morrhuate solution, once to several times in 0.5 to 2 c.c. amounts, is extremely effective in the usual hemangioma. It is less effective in the cavernous and racemose type.

The prognosis in hemangioma is invariably good. This is due to a number of factors: (1) inherently limited growth; (2) in the orbit the growth is usually

encapsulated and lends itself to excision; (3) radio-sensitivity; (4) satisfactory response to sodium-morrhuate injections. None of our cases showed unrestricted growth or proved fatal. The only instance in Watson's and McCarthy's large series of 1,001 cases, in which the growth was not eventually arrested and proved fatal, was in one case of racemose hemangioma.

Pseudotumor. Although seldom mentioned in the literature, a chronic cellulitis or lymphogranuloma which is usually called "pseudotumor" was found in this series to be the second most common orbital lesion to produce exophthalmos. It may resemble a real tumor so closely that clinical differentiation is impossible Of 30 cases analyzed in the literature, 15 patients, or 50 percent, had had exenteration of the orbit for a supposed tumor which was proved by histological examination to have been a chronic inflammation. Further analysis of these cases revealed the following characteristics:

(1) The average exophthalmos produced was 7 mm.

(2) A firm mass, well demarcated and discrete, was palpable in the orbit in half the cases.

(3) The vision was affected in two thirds of the cases and usually returned to normal after regression.

(4) Complete regression, which often proceeded to enophthalmos and sinking of the tarsoörbital fascia, took place usually in from 4 to 5 months.

(5) Occasionally there was prodromal transitory edema of the lid and conjunctiva some weeks or months preceding the appearance of the exophthalmos.

(6) The condition was never recurrent. (Since the analysis of these cases the writer has had the following experience with a case of pseudotumor of the orbit: M. H., a female, aged 60 years, had an exophthalmos of 5 mm. on the right side, and a mass was palpable through the lower lid and through the upper lid above the inner canthus. Biopsy showed it to be a lymphogranuloma. X-ray treatment was given in fractionated doses, and the tumor regressed in four months with subsequent retraction of the tarsoörbital fascia. The patient was well for 15 months and then the left eye became proptosed 6 mm. A mass was palpable through the lower lid over the outer one third. X-ray treatment was given in fractionated doses, and there was complete regression in three months followed by retraction of the tarsoörbital fascia. Four months later a smooth, rather firm, nonmovable mass, the size of a walnut, appeared in the right frontal region and was shown by aspiration biopsy to be a lymphogranuloma. This regressed in several months. The patient was well for two and a half years and then had an exophthalmos of 4 mm. on the left side. At the same time there was a smooth, rather diffuse, bony-hard mass, measuring 3½ cm. in diameter and elevated about 2 cm., on the left side of the forehead just lateral to the glabella. Roentgenograms revealed an increase in the soft-tissue density and a small elevation of the outer table of the frontal bone. An aspiration biopsy showed that the mass was a lymphogranuloma and X-ray therapy was administered in fractionated doses. The exophthalmos disappeared in three months, but the lump on the forehead required one year for complete regression. A year and a half later a mass measuring 5 cm. developed in the left supraclavicular region and was shown by biopsy to be a lymphosarcoma. This disappeared under X-ray therapy. A year later the patient complained of a swelling of the right foot. This was found to be due to a mass at the brim of the pelvis on the right side which was apparently pressing on the large vessels there. At the same time a mass as large as a good-sized

grapefruit was palpable in the right upper quadrant. Under X-ray treatment these masses have disappeared. This last episode was four months ago and the patient is now free of complaints. At no time has the white blood count been increased or shown any abnormal differential count. This, then, is a case of pseudotumor of both orbits which was recurrent in the left and in which the patient subsequently developed tumor masses elsewhere that proved to be lymphosarcoma.)

The most important points in differentiating a pseudotumor from a real tumor are the following:

(1) Primary tumors tend to occur at an early age; the average age for the pseudotumor is 45 years.

(2) The onset of exophthalmos in primary tumors is insidious and gradual; in pseudotumors it is relatively sudden, the exophthalmos developing within a few weeks in most instances.

(3) Primary tumors of the orbit are never bilateral; pseudotumors affect both eyes in one third of cases, the second eye becoming involved in from four to nine months after the first.

(4) Primary as well as secondary tumors of the orbit not infrequently show radiographic changes of the orbital bones; pseudotumors characteristically do not.

(5) Primary tumors usually cause no pain and no edema of conjunctiva or lids; pseudotumors cause some pain and some edema in one half of the cases.

The microscopic examination of tissue in cases of pseudotumor shows chronic inflammation with certain distinguishing characteristics. There may be fibroblastic repair in all stages, from the denser hyaloid, almost anuclear tissue of long standing to the delicate fibroglia and richly nuclear tissue of more recent production. Foci of lymphocytes are scattered through this fibrous tissue, and occasionally real lymph follicles with germinal centers are encountered. Blood vessels are plentiful, their intima often showing proliferation to such an extent that the lumen appears almost occluded, and their media and adventitia showing thickening with sclerosis that has sometimes undergone hyaloid degeneration.

The etiology of pseudotumors is not known. There is no evidence clinically or histologically to indicate that they are tuberculous. Some observers believe them to be a very late manifestation of syphilis that has run its course and therefore gives a negative Wassermann. There are reports of regression of the exophthalmos under the usual treatment for late syphilis, but the effect may have been absorptive rather than specific as the condition when untreated subsides in the course of several months. The histologic characteristics of the lesion, and in particular the vascular changes described above, are not inconsistent with syphilis, but the sum total of evidence is inconclusive. The patients do not have positive serology nor other evidence of syphilis.

Two of the 18 pseudotumors of this series had not progressed to exophthalmos. The patients in both cases exhibited diplopia, however, which is mentioned in the literature in about 25 percent of cases as the first symptom of pseudotumor, preceding the onset of exophthalmos, and which indicates that the tumor mass is related to an extraocular muscle. Examination of biopsy material not infrequently shows the process associated with muscle tissue, and it may be in the extraocular muscles that the lesion has its origin. The one case of Zenker's waxy degeneration of a rectus muscle listed in the causes of exophthalmos from lesions primary in the orbit had the clinical characteristics of a pseudotumor. The histopathology was also quite similar. It is possible, therefore, that other cases in

the group of so-called pseudotumor belong to the more advanced stages of Zenker's waxy degeneration.

To sum up, pseudotumor is a clinical and histopathologic entity of unknown etiology. Although the clinical picture may closely resemble that of an orbital neoplasm, the age incidence, onset, course, and duration are characteristic. It may be possible in the future to classify pseudotumors according to etiology, as, for example, some may be found to be related to lymphogranuloma venereum, others to lymphosarcoma, and others to Zenker's waxy degeneration; I have seen one case in a patient who subsequently developed Hodgkin's disease.

Meningioma. Next in order of frequency as a primary cause of exophthalmos in this series was meningioma, a tumor characteristically insidious in onset and slow in growth. The age of the patients ranged from 12 to 58 years, averaging 40 years. In most instances it is impossible to determine from the clinical findings alone whether a meningioma producing an exophthalmos is primary in the orbit or in the cranium, or, if it is in the former site, whether or not it has already extended into the cranium. If primary in the cranium it may give no neurological signs. If the meningioma is primary in the orbit a disturbance of vision followed by optic atrophy is frequently the first manifestation and may precede the exophthalmos by several years. The presence, though, of normal vision and normal fields does not exclude a meningioma, for rarely they may both persist with the optic nerve embedded in tumor tissue. Arising as it does from the sheaths of the optic nerve, the tumor lies in the muscle funnel at the apex of the orbit; in this position it is surrounded by the extraocular muscles, and their dysfunction is one of its early signs. It is also in close relation to bone, which it tends to invade, producing a hyperostosis; when this occurs in the apex of the orbit, extension is toward the cranial cavity. Close relationship to the optic foramen, moreover, as well as to the superior orbital fissure, further encourages the growth to spread directly to the cranium.

It is not uncommon for symptoms from an optic-nerve-sheath meningioma to exist for years before the diagnosis is made and treatment instituted. In one of our cases the patient had poor vision and optic atrophy for five years and an exophthalmos for two additional years before operation.

X-ray studies are indispensable in diagnosing meningioma, and in the large majority of instances are our only means of determining the status of the lesion. X-ray findings in the 13 cases of this series indicated that the tumor was primary in the orbit in four, but enlargement of the optic foramen in two of these suggested that there had been an extension toward the cranium. In one an exenteration with radical dissection at the apex of the orbit, followed by X-ray therapy given in fractionated doses, failed to arrest the lesion. There was a recurrence three years after the operation, and the patient died of an intracranial hemorrhage. In the other case there has been a local recurrence in the orbit, but no neurological signs had appeared when the patient was last seen, 10 years after the operation. X-ray evidence of meningioma in the other nine cases was atypical in two but definitely indicative of tumor primary in the cranium in seven. Meningioma primary in the orbit, therefore, was the exception in this series and still more exceptional were cases confining themselves to the orbit without intracranial extension. When primary in the cranium they produced exophthalmos by extension through, or hyperostosis of, the floor of the anterior cranial fossa, or by extension

from the middle cranial fossa to the orbit *via* the superior orbital fissure.

Cushing described intracranial meningioma as growing in two ways, either as a more or less irregularly lobulated mass with a small stalk attaching it to the dura, or "en plaque" as a more or less flat and only slightly elevated mass tending to spread over the inner dural surface. The meningiomas arising in the orbit seem more often to grow in the former way, and those extending there secondarily more often in the latter.

Meningiomas involving the orbit frequently present a serious treatment problem. Exenteration alone is rarely indicated because of intracranial extension or bone involvement. More frequently the situation lies in the domain of the neurologic surgeon as well as the ophthalmic surgeon, and in some instances the former alone would probably give the patient the best chance of recovery.

Hudson and Lundberg have both reported cases of orbital meningioma in which the tumor was incompletely removed and there was no recurrence approximately six years afterwards. This in no way rules out the possibility of a recurrence, however, for the tumor grows so slowly that it is not uncommon for one to reappear after an interval of many years and there may be no symptoms for a still longer period, even 20 years or more. One of our patients showed exophthalmos 20 years ago; two years later a Krönlein operation was performed with incomplete removal of the tumor. There was a recurrence, and seven years ago an exenteration was done. Since then there has been a slow but steady regrowth of the tumor but the patient is still living and well. The tumor now fills the orbit and manifests itself also as a mass in the temporal region. Neurological examination is negative. Another patient had the first symptom 18 years ago (poor vision with optic atrophy) and exophthalmos three years later. Roentgenograms at that time showed that the growth probably began in the orbit, but the optic canal was somewhat enlarged. A Krönlein operation with incomplete removal of the tumor was performed after another three years. Since then there has been a slow recurrence, but the patient is living and well. Exophthalmometer readings taken twice a year have shown an exophthalmos of 10 mm. for the past six years. Neurological examination is negative.

Irradiation was applied to the recurrent tumors in both these cases, as X radiation in fractionated doses to one and as radium to the other. Meningiomas are known to be irradiation-resistant and it is unlikely that the treatments had any material influence on the course of the disease.

Both Schuster and Li have reported instances of the metastasis of a meningioma through the blood stream.

Dermoid and epidermoid cysts usually occupy the orbital margin in the region of the brow temporally or, less often, nasally. Because of their predilection for this forward position they frequently do not produce exophthalmos. In a number of cases, however, they lie more deeply in the orbit or extend from the usual superficial location back along the bony wall to the retrobulbar region and give rise to proptosis. They are congenital and are usually detected in young individuals. The age range in our cases was from four months to 36 years, the average 15 years. After remaining dormant for years they may begin to enlarge slowly and will sometimes grow so rapidly in the course of weeks or months as to produce pain. X-ray studies are frequently of great help in the diagnosis, as the cyst may produce a defect in the adjacent bony wall of the orbit.

Sarcoma of the orbit is, as a rule, a

rapidly growing, highly malignant tumor occurring in young individuals. It may arise from a great variety of cell types: connective tissue (fibrosarcoma), muscle (rhabdomyosarcoma), nerve (neurogenic sarcoma), periosteum (osteogenic sarcoma), and lymphocytes (lymphosarcoma). In some instances it is growing so rapidly and is therefore so anaplastic that certain identification of the cell type is impossible.

Lymphosarcoma is exceptional in that it occurs in older persons. The average age in this group is 55 years, and two of the five patients are living now with no evidence of the disease, after 3 years and 2½ years, respectively. Three patients died after six months, 1 year, and 2½ years, respectively. These tumors are radio-sensitive and respond locally quite satisfactorily to irradiation, but unfortunately the growth in the orbit usually proves to be only one manifestation of a fatal systemic disease.

The two patients with rhabdomyosarcoma warrant mentioning because they both had an exenteration followed by irradiation, and the one is free of disease now 15 months and the other 18 months after the operation.

Neurogenic tumors. Of the neurogenic tumors the neurofibroma is by far the most common, and its appearance is so characteristic that diagnosis may usually be made without difficulty. There are the café-au-lait pigmentation of the overlying skin, the multiple small neurofibromata, or the multiple pigmented naevi over the skin, and the extensive area locally involved by the tumor which may be not only the orbit but the lids, face, scalp, choroid, ciliary body, and iris, and may even extend into the cranium. The intraocular manifestations may produce glaucoma. This tumor also tends to produce defects in the adjacent bones of the orbit and X-ray films may give valuable information. When the bony defect occurs in the roof of the orbit, the brain may herniate and give rise to a pulsating exophthalmos. In this series the ages varied from 4 to 41 years. Half the cases with orbital involvement did not produce exophthalmos.

Glioma of the optic nerve is an exceptionally interesting condition and should be included in our discussion in spite of its extreme rarity. Composed of neuroglia, it is correctly called "glioma," but there has been some discussion as to whether the type cell is the astrocyte or the oligodendrocyte. Davis has championed the former and believes therefore that the tumor should properly be called an astrocytoma. Lundberg, on the other hand, favors oligodendrocytoma. Davis also considers the tumor to be closely related to the neurofibroma with which it may be associated. It is extremely slow in growing, and produces exophthalmos gradually in children in the first decade. X-ray studies may show an enlargement of the optic foramen and deformity of the sella turcica in cases of chiasmal involvement. Vision is usually affected before the onset of exophthalmos.

Verhoeff discusses very interestingly the origin and growth of these tumors. Ordinarily a tumor arises from a small focus and as it grows it pushes aside and invades the surrounding tissue. In the case of glioma, whether it be in optic nerve, brain, or cord, the growth increases in size by causing the preëxisting neuroglia in the vicinity of the growth to proliferate. Sometimes this glial proliferation is seen as far forward as the disc and contiguous retina, where, in some instances, it may reach considerable size and form a white or even a cystic mass; or it may be noted as far back as the hypophysis. Verhoeff's explanation of the proliferation of the neuroglia of the disc and contiguous retina, and perhaps also

of the hypophysis, is that some abnormal stimulating factor is supplied in increasing abundance by the actively proliferating neuroglia of the tumor. This would also explain the remarkable statement by Hudson that "in spite of the frequency of incomplete removal, in no single case has a local recurrence in the orbit been recorded." Lundberg tells of two cases in which the tumor was not radically removed and there was no recurrence evident after 10½ and 20 years, respectively. Seefelder has reported one case in which there was recurrence after three years, and this is apparently the only case of a recurrence on record.

These tumors may occur in both optic nerves or in the chiasm or brain as well as in the optic nerve. This fact of multiple origins is sometimes important in determining the extent of the surgery required.

Mixed tumor of the lacrimal gland. The large majority of newgrowths of the lacrimal gland contain tumor tissue that is both ectodermal and mesodermal in origin. These growths are therefore called mixed tumors and they constitute about 95 percent of the neoplasms that arise from the lacrimal gland. Pure carcinoma of the gland is extremely rare, and it is believed that most of the cases reported in the literature are in reality mixed tumors that have become malignant. Sarcoma of the gland has been reported only twice.

These mixed tumors are probably congenital, although the average age at which they manifested themselves in this series was 40 years. They seem to arise from isolated, displaced, and undifferentiated embryonic rests and not from the developed gland tissue. Because they are potentially capable of forming many types of tissue they naturally vary a great deal in their component structures. The term cylindroma has been employed to designate one particular manifestation of this tumor in which the epithelial element predominates in cylinder formation with myxomatous stroma.

That this tumor occurs in patients middle-aged and older, that it arises from the site of the lacrimal gland, and that it tends to produce radiographic changes indicative of localized defects or hyperostosis of the adjacent bone, are facts which serve to make diagnosis relatively easy. Characteristically the tumors seem well encapsulated and not invasive and therefore inherently benign, but, as Sanders points out, they must be viewed clinically as malignant growths because of the extremely high frequency of recurrence after excision, the marked tendency to local invasion not only of the orbital tissue but particularly of the orbital bones, and the frequency of distal metastases (Sanders 33 percent). Death from intracranial extension is not infrequent (Sanders 42 percent).

Other lesions. In this series the seven groups described above comprise 87 percent of the cases of exophthalmos from causes primary in the orbit. Such causes as lymphoma, hematoma, and the like, are so rare that they will not be discussed. It is a question, indeed, whether lymphoma and xanthoma should be considered strictly primary in the orbit, as lymphoma may represent an early manifestation of a lymphatic leukemia and xanthoma of the orbit may be considered a part of xanthomatosis from faulty fat metabolism. The orbital hematomas are interesting in that they are the delayed type comparable to the chronic delayed intracranial hematomas that may manifest themselves many months following trauma.

To be concluded

COLOBOMA OF THE OPTIC NERVE IN THE HUMAN EMBRYO*

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Colobomas of the optic nerve are so rare in the human embryo that an exhaustive study of the literature failed to show a single case as typical as the one, obtained in 1934, which forms the basis of this report. Several colobomas in the embryonic eyes of animals and chicks have been described. The few cases that occurred in man were reported after enucleation had taken place, and were found either in adult eyes or in eyes that had been removed some time after birth.

The coloboma to be described occurred in a human embryo measuring 61 mm. in length, corresponding to an approximate age of 80 days (figs. 1, 2, 3). It was one of a group of specimens of 70 human embryos collected over a period of five years, and it represented the only definite anomaly of the optic nerve in this collection.†

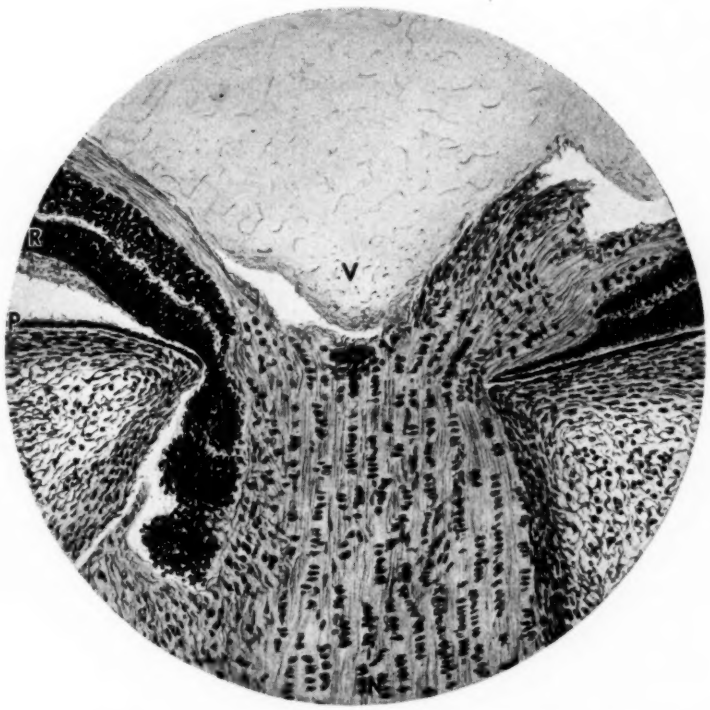

Fig. 1 (Payne). High-power magnification of invagination of retina into optic-nerve stalk in 61-mm. human embryo. R, retina; P, pigment epithelium; N, optic nerve; V, vitreous body.

The inclusion of the retina in the stalk of the optic nerve undoubtedly followed

*Candidate's thesis for membership in the American Ophthalmological Society, 1939. Aided by a grant from the Ophthalmological Foundation, Inc.

†From the embryologic collection of the Lighthouse Eye Clinic and the New York Eye and Ear Infirmary.

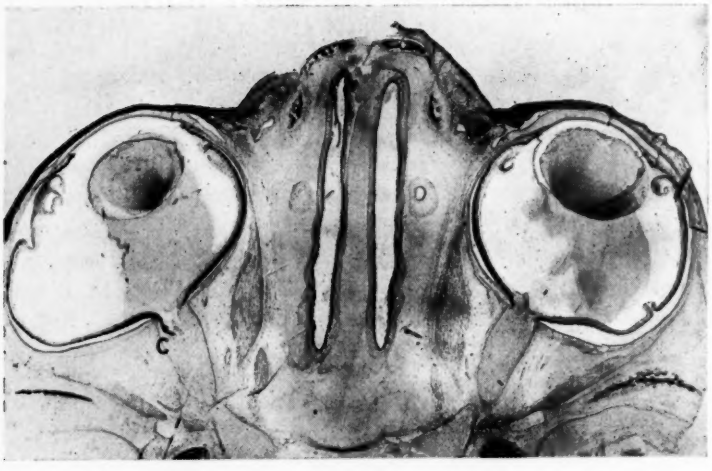

Fig. 2 (Payne). Transverse section of both eyes in the 61-mm. human embryo, showing the coloboma, C, of the left optic nerve below the plane of the central retinal artery.

a rapid overgrowth of the retinal elements. The fact that the retina grows more rapidly than other structures in early embryonic life will be demonstrated by three younger human specimens from this collection.

Anatomic description

The coloboma reveals a distinct invagination of the retinal elements into the optic nerve, with a corresponding condensation of the glial cells and disruption of the columns of nuclei on the temporal side (fig. 4). The defect measures approximately three quarters of a disc-diameter in depth, and varies from one third to two thirds of a disc-diameter in breadth. Its greatest thickness and depth appear to be in the horizontal sections immediately below the plane of the central retinal artery. Above and below this plane the anomaly gradually resolves itself into normal nerve tissue. The defect is partially filled with an overgrowth of retinal elements, attached, both to the mesodermal tissue surrounding the central vessels and to the dural sheath, by a comparatively dense mixture of glial and mesodermal tissue. In the intraneural portion the retina is well preserved, and

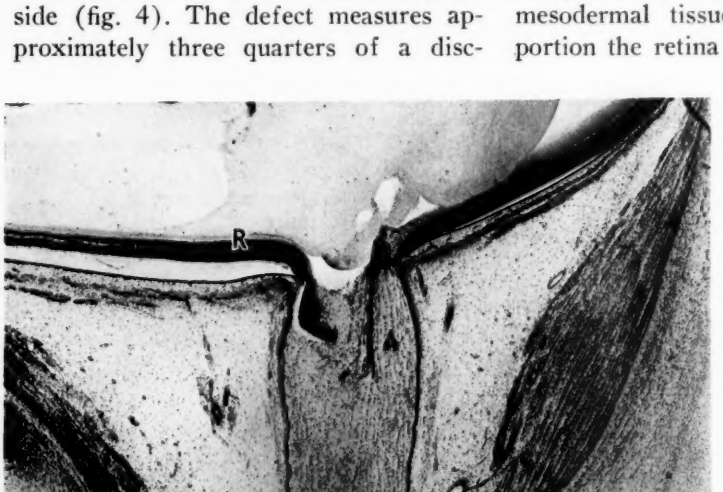

Fig. 3 (Payne). Photomicrograph of the nerve at the level of the central retinal artery. R, retina; A, central retinal artery.

the internal and external nuclear layers are as well defined as in the intraocular portion. Some of the sections show the retina sweeping around the margin of the scleral canal in the shape of a reversed "S" (fig. 4), and at lower levels show it to be invaginated parallel to the dural sheath, but separated from it by an artifact (fig. 1). In the lower portion of the nerve the pigment epithelium ends abruptly at the scleral canal, but at higher levels it extends to approximately one half the thickness of the sclera. The retina appears to have detached itself from the pigment epithelium and to be caught in glial and mesodermal tissue. Where it arches around the scleral prominence, the retina is reduced to the external nuclear layer and the nerve-fiber layer, and resembles the macular region. The choroid is only partially formed. The pial sheath on the temporal side is replaced by the retina. On the inner side of the retina the nerve-fiber layer, corresponding to the papillomacular bundle, is replaced by a mass of glial tissue. There is no evidence of the lamina cribrosa, which, at this stage of development according to Haden,[1] is composed wholly of glial tissue. The vitreous body does not fill the excavation, but is separated by an artifact.

The nasal side of the nerve appears to be normal. The columns of nuclei are regular; the central artery is pushed nasally by the aberration, but it continues into a glial mound, where it enters the canal of Cloquet.[2] The retina and pigment epithelium end abruptly at the margin of the disc, as in the normal globe. In other respects the eye appears to be normal.

Fig. 4 (Payne). High-power photomicrograph showing a part of the central retinal artery. C, regular columns of nuclei; G, glial and mesodermal tissue attached to R, retina.

According to the preparations, an overgrowth of the retina on the temporal side is present. The proliferation is so extensive that a fold is caught in the substance of the optic nerve. In all probability the defect was outlined in the formation of the primitive optic papilla, and according to this supposition it confirms the belief that ectodermal proliferation is one of the characteristics of fetal development. As a possible cause, Lloyd[3] suggested an increase in the intraocular pressure with a defective lamina cribrosa. Wilmer[4] attributed the cause of the de-

Fig. 5 (Payne). Human embryo. 5½ mm. in length, showing the formation of the primary optic vesicle from the forebrain. E, surface ectoderm; L, anlagen for lens vesicle; R, retina; P, pigment epithelium; N, primitive optic nerve; M, mesoderm.

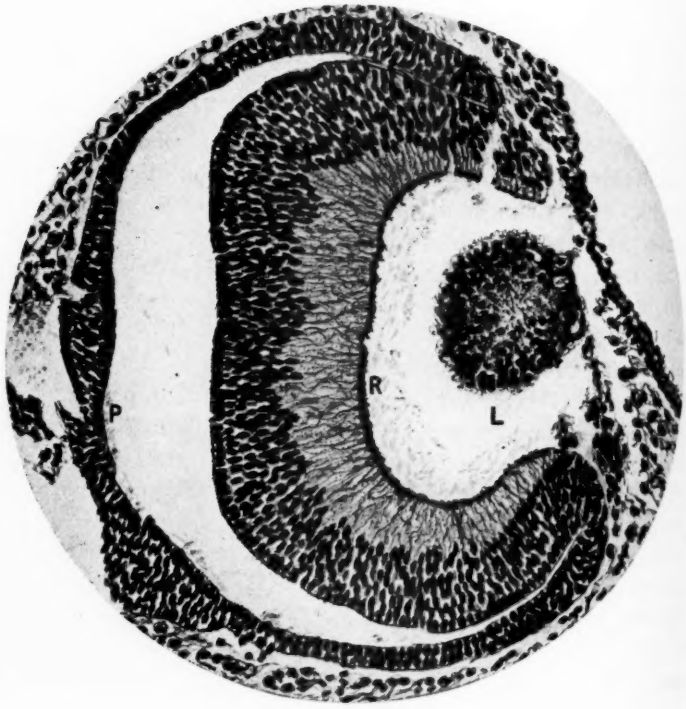

Fig. 6 (Payne). Eye of 10-mm. human embryo showing rapid retinal growth. P, pigment epithelium; R, retina; L, lens.

fect to ectodermal overgrowth, and regarded the specimen as a true case of pitting of the optic nerve. All sections on the temporal side show an increase in the expanse of the retina, although there is no increase in its thickness. It appears that the coloboma was formed to accommodate this increased expansion. It is possible that, in its growth, the mesoderm caused traction on the retina, pulling it into the nerve and toward the central vascular strand.

Anatomic description of retinal overgrowth in three normal younger embryos

In order to demonstrate normal retinal overgrowth, an anatomic description of three younger human specimens follows:

Embryo 1: The 5½-mm. specimen (fig. 5), corresponding to an age of 21 days, shows budding of the primary optic vesicle from the forebrain, with marked increase in the development of the anlage for the retina and the pigment epithelium. The associated mesoderm and the surface ectoderm fail to show similar development. There is a suggestion of thickening on the surface to form the lens plate. The size and thickness of the cells that are to form the retina are slightly greater than those that are to form the pigment epithelium.

Embryo 2: The 10-mm. specimen (fig. 6), representing an age of 31 days, shows a complete change in the relationship of the retinal and the pigment epithelial cells. The pigment epithelium is less than one half the thickness of the retina. The cells forming the retina appear markedly developed, and only the lens vesicle is developed to a degree corresponding to that of the retina. An invagination of the retina into the primitive optic disc would be possible at this stage.

Embryo 3: A specimen measuring 52 mm. in length, corresponding to 72 days of age (fig. 7), shows the retina to be many times thicker than the pigment epithelium. The crystalline lens exhibits a high degree of development. The optic nerve appears to be normal for this age.

Discussion of proliferation of neural ocular ectoderm

The inherent tendency of the ectodermal ocular anlage to proliferate has been demonstrated by von Szily,[5] Lauber,[6] Elschnig,[7] and others. That the complex formation of the primitive epithelial papilla may explain the variety of the malformations that occur in the formation of the nerve was pointed out by Klien[8] in her study of the orbital appendages of the optic nerve. According to Seefelder,[9] von Hippel[10] published the first accurate description of ocular colobomas. Von Hippel assumed that a thickening of the mesoderm in the fetal ocular cleft prevented union of the retina, pigment epithelium, and choroid. Seefelder[11] demonstrated that the closure of the ocular cleft began in the middle and advanced distally toward the cup and proximally toward the stalk of the nerve. He believed that if the cleft should fail to close in its proximal portion, a coloboma of the nerve would result. Von Szily[12] and Bach and Seefelder[13] observed that no special thickening of the mesoderm occurred in the coloboma of a rabbit. From these studies it was concluded that either marked proliferation or almost complete retardation of growth of the epithelial elements precluded pitting or coloboma formation. According to Collins and Mayou,[14] if the growth is accelerated, a cyst is formed that may be lined with defective retina and pigment epithelium, or with retina alone.

Theories of development of atypical colobomas

Various explanations are given for the

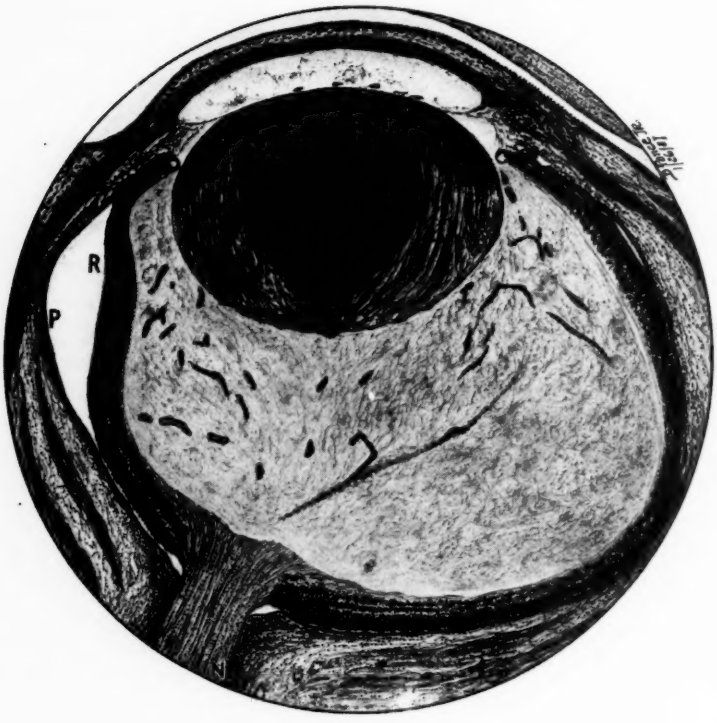

Fig. 7 (Payne), Normal 52-mm. human embryo. P, pigment epithelium; R, retina; N, optic nerve.

Fig. 8 (Payne). Partial coloboma of optic nerve occurring in a woman 37 years of age. C, partial coloboma.

development of atypical colobomas. Vossius[15] attributed them to retardation of development in the globe, and von Szily[16] believed that they were caused by blood vessels winding around the optic cup. However, Wolfrum[17] discovered three depressions in the margins of the optic cup of a human embryo in which the vessels were too small to compress the cup. On this basis he ascribed a variation in growth energy as the cause of colobomas. Rones,[18] after studying a number of human embryos, concluded that growth occurred in successive waves, and that indentations in the margin of the cup frequently disappeared because of counterpressure from other structures.

According to Mann,[19] the extreme upper end of the fetal ocular cleft in the human globe does not close. It remains as a passage of entry for the central retinal artery in the center of the disc. The papilla of Bergmeister,[20] which is a glial and mesodermal mantle surrounding the central retinal artery, disappears as the nerve fibers increase in number and enter the optic stalk.

Congenital pitting of the optic nerve was defined by Coats[21] as a craterlike hole in the disc, measuring from one sixth to one third the diameter of the nerve, and having no relation to the ocular cleft. As to dimensions, he stated that a pit may have a depth of 9 mm., and is usually lined with degenerated retina and pigment epithelium. The anomaly described in this paper belongs neither to this group nor to the anomalies classified as atypical colobomas, but, because of its relation to the ocular cleft, belongs rather to the group of typical colobomas.

Clinical case of partial coloboma

Physiologic cupping of the optic nerve is observed almost daily by the opththalmologist, but pitting and colobomas are rare. Through the courtesy of Dr. Conrad Berens, a clinical case of partial coloboma of the right optic nerve, occurring in a woman aged 37 years, was seen in 1937. She accepted a −8.00 D. sphere, which improved her vision to 20/200. She had an enlarged blind spot, central scotoma, and concentrically contracted fields. The intraocular tension was normal. The depth of the excavation (fig. 8), measured with a binocular ophthalmoscope, was estimated to be 4 mm. This case is presented to illustrate how the anomaly in the 61-mm. human embryo here described histologically might have appeared clinically if the globe had reached maturity.

Summary

1. An overgrowth of the retinal elements in a 61-mm. human embryo resulted in the inclusion of a fold of the retina in the optic nerve on the temporal side.

2. The pigment epithelium was not included in the fold.

3. Glial and mesodermal tissue replaced normal nerve markings on the temporal side, with disorganization of the columns of nuclei.

4. From the histologic picture it is assumed that central vision would have been lost because of an interference with the papillomacular bundle had the embryo developed to maturity.

References

[1] Haden, H. C. Amer. Jour. Ophth., 1925, v. 8, p. 1.
[2] Cloquet, J. G. Mémoire sur la membrane pupillaire et sur la formation du petit cercle artériel de l'iris. Paris, 1818.
[3] Lloyd, R. I. Personal communication, 1936.
[4] Wilmer, W. H. Personal communication, 1934.

[5] Von Szily, A. Arch. f. Ophth., 1921, v. 106, p. 195.
[6] Lauber, H. Zeit. f. Augenh., 1909, v. 21, p. 494.
[7] Elschnig, A. Arch. f. Ophth., 1900, v. 51, p. 391.
[8] Klien, B. A. Arch. of Ophth., 1936, v. 16, p. 624.
[9] Seefelder, R. Kurzes Handbuch der Ophthalmologie. Berlin, 1930, v. 1, p. 539.
[10] Von Hippel, E. Die Missbildungen und angeborenen Fehler des Auges. In: Graefe-Saemisch Handbuch der gesamten Augenheilkunde. Ed. 2, 1908, v. 2, chap. 9, p. 27.
[11] Seefelder, R. Arch. f. Ophth., 1915, v. 90, p. 129.
[12] Von Szily, A. Klin. M. f. Augenh., 1907, v. 45, Suppl., p. 201.
[13] Bach, L., and Seefelder, R. Atlas der Entwicklungsgeschichte des menschlichen Auges. Leipzig, 1911-1914, pts. 1, 2, 3.
[14] Collins, T. E., and Mayou, M. S. Pathology and bacteriology of the eye. Ed. 2, Philadelphia, 1925, p. 27.
[15] Vossius, A. Klin. M. f. Augenh., 1885, v. 23, p. 173.
[16] Von Szily, A. Ref. 12.
[17] Wolfrum, C. Klin. M. f. Augenh., 1908, v. 46, pt. 2, p. 27.
[18] Rones, Benjamin. Amer. Jour. Ophth., 1934, v. 17, p. 883.
[19] Mann, I. C. Development of the human eye. Cambridge, 1928, p. 108.
[20] Bergmeister, O. Mitt. a. d. embryol. Inst. d. k.-k. Univ. in Wien (1877-1880), 1880, v. 1, p. 63.
[21] Coats, G. M. Roy. London Ophth. Hosp. Rep., 1908, v. 17, p. 178.

EQUATORIAL SCLERAL STAPHYLOMA AND RETINAL DETACHMENT CURED BY EXCISION

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The combination of scleral staphyloma and retinal detachment is probably not so rare as a search of the ophthalmic textbooks and literature would lead one to believe. The nature of the condition is conducive to retinal detachment as one of its sequelae. So far as could be determined, no case of cure of the detachment and probable arrest of the progress of the staphylomatous process by excision has hitherto been reported.

A white woman, aged 57 years, was refracted by her son-in-law, Senior Resident in Ophthalmology, Cincinnati General Hospital, on April 2, 1936. Except for the refractive error in each eye here recorded, the examination revealed no discovered abnormality. Vision in the right eye with -1.75 D.cyl. ax. $145° = 20/20$; in the left eye with -1.00 D.sph. $\bigcirc\!\!\!\!\bigcirc$ $+1.75$ D.cyl. ax. $115° = 20/20$, addition of $+2.50$ D.sph. $=$ J.1 in each eye. These glasses were ordered. Due to the absence of anything unusual in the ocular past history, the staphyloma about to be described, while undoubtedly present, was not discovered nor its presence suspected.

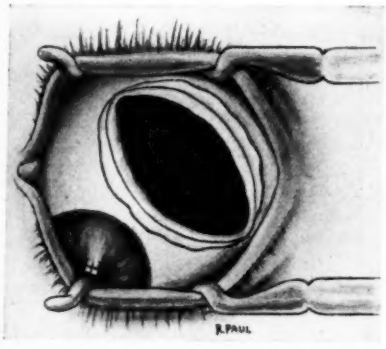

Fig. 1 (Vail). Diagrammatic appearance and position of the staphyloma.

On June 15, 1926, the patient suddenly noticed a blur in the vision of the left eye, which rapidly became worse. An extensive retinal detachment was found and she was admitted to the hospital on June 29th. On the following day my examination showed a large balloon detachment of the retina, involving the entire upper temporal portion of the globe, along with a widespread flat detachment of the remainder of the retina, save for a small portion up and nasally. No tear nor hemorrhage was seen. Vision was limited to the ability to detect hand movements down and out. The field of vision was restricted likewise to a small patch in the lower temporal quadrant. The ocular tension was soft. Transillumination was negative. Operation was performed the same morning. On exposure of the scleral operative field from the 12 to the 5-o'clock position, 10 mm. from the cornea, a typical scleral staphyloma, entirely unsuspected, was revealed (fig. 1). It measured roughly 12 by 15 mm., and began abruptly at a point 6 or 7 mm. from the limbus. It occupied the area between the tendons of the superior and external recti muscles, and therefore was obviously over the retinal balloon. A diathermy-coagulation operation had been planned, but in view of this situation it was decided to excise the staphyloma in a method similar to the eyeball-shortening operation described by Lindner in 1933.[1] Two double-armed sutures were inserted along the edges of the staphyloma (fig. 2) and looped out of the way. A fixation suture was placed in the center of the ectasia. A Graefe-knife incision was made along the upper and inferior edges, and excision was completed with curved scissors (fig. 3). The

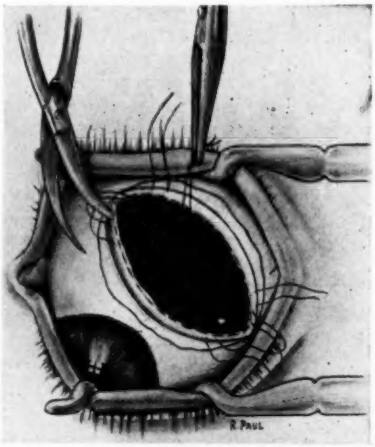

Fig. 2 (Vail). Showing the value of the fixation suture.

Fig. 3 (Vail). Diagrammatic drawing of position of sutures.

Fig. 4 (Vail). Showing closure of the wounds.

fixation suture was of incalculable value at this point, for traction on it gave excellent control of the eyeball and the portion being excised, and at the same time created a negative pressure which prevented vitreous from spilling. Subretinal fluid and presumably fluid vitreous were lost, but, on completion of the excision, which included part of the retina, the main vitreous body could be seen glistening darkly like water deep in a well. The sutures were quickly tied, and a third was placed between them (fig. 4), thus bringing the edges of the wound tightly together and forming a small linear ridge of sclera.

Convalescence was uneventful. The first dressing, on July 2, 1936, showed the eye to be in good condition. On July 4th a good red reflex was obtained. The cut edge of the retina could be seen as an elevated, edematous border beyond which was a dark-red area of

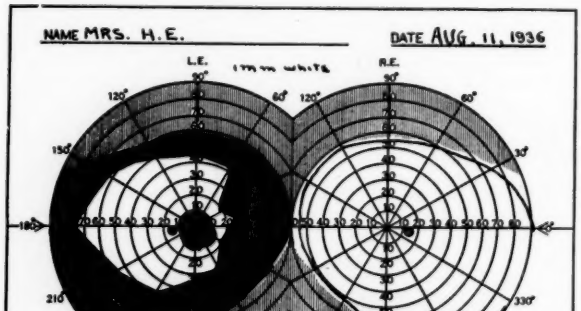

Fig. 5 (Vail). Visual fields on August 11, 1936.

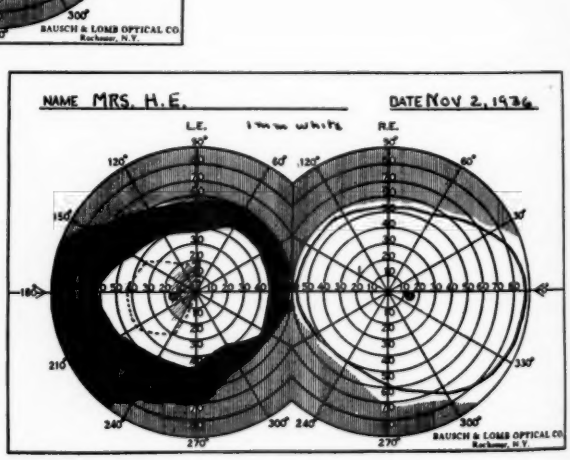

Fig. 6 (Vail). Visual fields on November 2, 1936.

blood clot. The vitreous was remarkably clear. On July 16th beginning pigmentation of the cut edge and vitreous opacities on the temporal side were observed. The patient was discharged on July 21st, and the following notes were made on her record: "The cornea bright and clear. Vitreous very clear except for a few strandlike floaters in the neighborhood of the operation. Vertical fold in the retina to the nasal side of the scar. Entire retina somewhat wavy, but the red reflex is bright and clear. Edge of the excised area becoming pigmented. The optic-disc outline normal. Vision = ability to count fingers at 6 feet."

On August 11th, six weeks after the operation, the vitreous showed a few floating opacities, and the entire retina seemed to be wrinkled. Vision in the left eye with +3.50 D.sph. ⌭ +4.50 D.cyl. ax. 20° = 20/70. The field of vision is shown in the chart (fig. 5). On November 2, 1936, the patient was able to read J.2 slowly with correction, although the macular area was somewhat edematous. The distance vision = 20/70 + 1 with the above correction. The field of vision is shown in the chart (fig. 6).

On June 8, 1938, approximately two years later, examination showed that the vision had improved to 20/40 (every letter) with +2.00 D.sph. ⌭ +4.50 D.cyl. ax. 35°. Adding +2.50 D.sph., she read J.1 slowly, missing some of the longer words. The site of the wound was smooth and flattened obliquely. There was a slight bulging of the sclera down and out and up and in, due to the resection of the sclera between these two areas. The nerve head was normal. There was light, irregular pigmentation of the macular area. The site of the wound in the retina was heavily coated with pigment. There was no sign of detachment. The ocular tension was normal (20 mm. Hg, Schiötz).

I am grateful to Dr. John S. McGavic, of the Eye Institute of New York, for the following notes of his last examination of the patient on October 27, 1939, and also for the drawing of the fundus (fig. 7) by the artist, Mr. Bethke, on that date. "Vision, right, 20/15—2 with —1.75 D.cyl. ax. 140°; vision, left, 20/30—3, missing one letter in 20/40 line, with

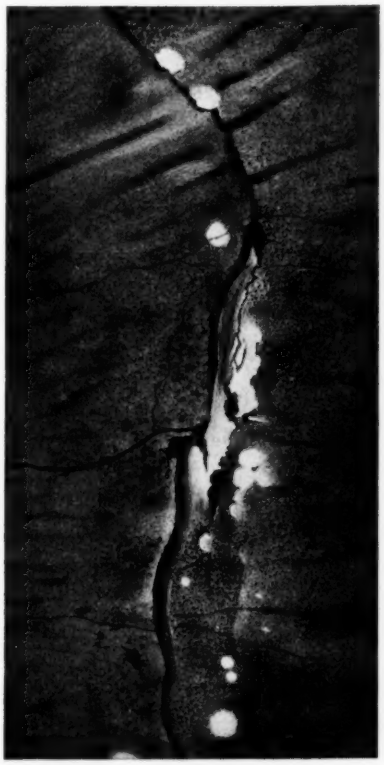

Fig. 7 (Vail). Fundus appearance on October 27, 1939.

+1.75 D. sph. ⌭ +5.25 D.cyl. ax. 25°. With an addition of +2.50 D.sph. she reads right J.1 and left, J.2. This small line of print appears to be slightly irregular but she reads it rather

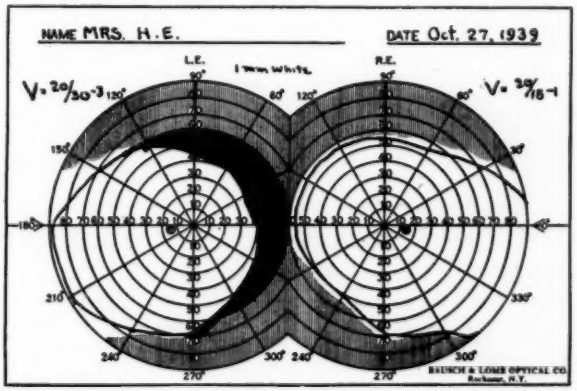

Fig. 8 (Vail). Visual fields on October 27, 1939.

rapidly. The left lens is clear. There are a few fine vitreous floaters. The scar from the operation appeared essentially the same as when you last saw it." The chart of the visual field (fig. 8) was enclosed.

Scleral staphylomata have been known and described for many years. The best description, I think, is to be found in Fuchs's "Textbook of ophthalmology"[2] and needs no further comment here.

Lindner's eyeball-shortening operation, described in 1933, is modified from that of L. Müller first presented in 1903[3] but more or less abandoned in the intervening years. Müller's operation was originally designed for retinal detachment in myopia, and in his first report he described three cases cured by this means. In 1913 he reported 15 additional cases with five cures. Holth,[4] in 1911, reported five cases with two improved; Török,[4] in 1917, 12 cases and six improved; Elschnig[4] in 1914, 11 cases and seven improved. A review of Lindner's work was ably presented in 1939 by D. K. Pischel and M. Miller[5] who added a case report of retinal detachment cured by the eyeball-shortening operation.

Summary

A patient with equatorial staphyloma and retinal detachment was presumably cured by excision of the staphyloma. The retina has remained in place, and at the end of three-and-one-half years the staphylomatous process has not progressed. The refraction changed from −1.00 D.sph. ⊂⊃ +1.75 D.cyl. ax. 115° prior to the detachment, to +1.75 D.sph. ⊂⊃ +5.25 D.cyl. ax. 25° three years after operation. From the experience of this case, and the reports in the literature of cures or improvement obtained in otherwise hopeless cases of retinal detachment, it will be seen that scleral excision has an important place in our surgical armament.

References

[1] Lindner, K. Treatment of prognostically unfavorable cases of retinal detachment. Zeit. f. Augenh., 1933, v. 81, p. 277.
[2] Fuchs, E. Textbook of ophthalmology (Duane trans.). Ed. 8 revised, Philadelphia, J. B. Lippincott, 1924, p. 615.
[3] Müller, L. A new operation for the cure of retinal detachment. Klin. M. f. Augenh., 1903, v. 41, p. 459.
[4] Elschnig, A. The equatorial scleral section of L. Müller (1903). Augenärtzliche Operationslehre. Berlin, Springer, 1922, v. 2, p. 1320.
[5] Pischel, D. K., and Miller, M. Retinal detachment cured by an eyeball shortening operation. Arch. of Ophth., 1939, v. 22, p. 974.

Discussion

Dr. H. M. Langdon: There is one phase of Dr. Vail's case which, I think, opens up quite an interesting question. To be sure, his case is not actually comparable to the ordinary case of detachment of the retina. Here we had a definite bulging of the sclera, which separated from the retina instead of the retina separating from the sclera, as occurs in the usual case of detachment. In performing the operation Dr. Vail necessarily made a very large tear in the retina, and yet, in spite of that tear, which he made no attempt to close other than merely to excise and remove the bulge and replace the sclera in its original position, the retina went back into place, and presumably has remained there for a period of three years. This seems to open up the question as to whether tears in the retina are as serious and have as much to do with the formation of the separation of

the retina as we sometimes assume. The effect of the tear on the retina and the question of detachment are to me most interesting points, which I do not believe are yet settled. In my opinion we should not neglect tears when we see them, and should make every effort to close them, although I am not sure that a tear is as serious in starting a detachment as we sometimes assume. It seems to me that this case of Dr. Vail's with the very large separation of the retinal continuity which he perforce had to make, proves that tears are not so important as we believe them to be.

Dr. Derrick Vail, closing: I wish to thank Dr. Langdon for bringing up a very interesting point. I am sure I cannot answer some of the questions raised by his discussion except to say that I do not know just exactly how the retina was severed. In discussing it with Dr. Verhoeff, we concluded that since the retina is so intimately connected with the staphylomatous process on the posterior portion, that is, toward part of the equator, in severing it some trauma was inflicted on the rest of the retina by the blades of the scissors. Examination of the retina on the tenth or twelfth day after the operation, when one could obtain a good view of it, showed a wavy white area, which no doubt was its edge, and the appearance was just about the same as that of a retina following diathermic coagulation; in other words, there was a whitish, edematous, elevated surface. As a matter of fact, I did not take time to investigate whether I had cut the retina or what I was looking at when I looked down into the deep well.

THE RELATIONSHIP BETWEEN MYOPIA AND AVITAMINOSIS

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New York

There is such widespread interest in vitamins and their most intimate relationship with all physiological functions that miraculous cures are expected from all the vitamins we know. Just because the lack of some vitamin is known to cause certain symptoms, we immediately bring into play "post hoc-propter hoc" reasoning in our treatment of related and unrelated conditions. Sometimes we even find some experimental proof for our wishful thinking.

Lately, we have had quite a bit of this excessive zeal in ophthalmology with reports of cures in all sorts of things. But so far, the only decisive, definite, and incontrovertible evidence of cure with vitamins in ophthalmology has been (1) in the use of the vitamin-B complex in cases of toxic amblyopia (alcohol-tobacco) as reported by Carroll[1] and by Johnson,[2] and in optic neuritis associated with pellagra as reported by me[3] and (2) the cure of keratomalacia, xerophthalmia, and associated ocular conditions by the use of vitamin A in numerous instances all over the world, and most recently very strikingly reported by Gamble.[4]

CLINICAL EXPERIMENTS WITH VITAMINS A AND D IN MYOPIA

Recently, there have appeared some articles on myopia and its possible relationship to A and D avitaminosis. One writer, Miller,[5] blames the limited intake of fats and A avitaminosis as the cause; another, A. A. Knapp,[6] deficient vitamin D intake with deficiency of calcium in the diet.

As mentioned in an article[7] (1939), I first became interested in the possible relationship between myopia and deficient vitamin-D intake in 1931, but by 1937 was completely disillusioned and had to admit that I had had no success in any cases of myopia by treating the patients with calcium and vitamin D.

However, in December, 1939, A. A. Knapp[8] indicated in his article that failure was due to insufficient dosage with vitamin D and that he gave 60 drops of viosterol plus large calcium dosage in the form of milk and calcium tablets. Of the 46 patients he lists in his article, 40 were 13 years of age or less and 24 were 9 years of age or less, and of all 46 patients, 26 were observed for only 8 months or less, some for even as little as 5 months. Of these 46, 38 showed no diminution in myopia; in fact, some of these 38 showed an increase, but all 38 were followed for less than a year! And we are dealing with myopic subjects in whom the increase of myopia is measured over a period of years, not months.

As I have pointed out,[7] many young persons who have myopia will show either a slight increase in the amount of myopia or none at all under no treatment at all other than corrective glasses. This is not uncommonly found in private practice. I have often remarked to the parents of such children that if vitamin D had been ordered in these cases, I should have been inclined to give the credit for the lack of increase in myopia to the vitamin D. But, and this is most important, these cases must be followed for 6 or 7 years, not for 6 or 7 months. For example, I cited the case of one patient in whom, over a period of 20 months, there had been an increase of myopia in one eye of only one-half diopter while in the other eye there had been no increase. But, on checking for the entire period of 4 years and 7 months, during which

time the patient was taking viosterol, the increase in myopia had been 1¼ diopters in one eye and 2½ diopters in the other.

There is another point of great significance: The great majority of the patients cited by A. A. Knapp were 13 years old or less, and more than half of them were 9 years old or less. These were the patients who were given the vitamin D and calcium. But it has been shown that in New York City vitamin-A deficiency in children and infants is a very uncommon disorder, and vitamins A and D these days are taken together. It is also known that there is great difficulty in separating vitamin A from vitamin D chemically; so much so, that if vitamin A alone is to be ordered, carotene, its precursor, must be prescribed.*

Tests were carried out by Lewis and Haig[9] on 53 infants and 144 children, most of whom were seen in clinics and most of whom "came from very poor homes." Dark-adaptation tests were used to determine if there was vitamin-A deficiency, and the authors came to the conclusion that "the margin of safety with respect to the vitamin-A content of the average diet of children is large. . . . It would, therefore, seem superfluous to supplement the average diet of children with vitamin-A-containing preparations except in those instances in which a considerable portion of the diet is refused or vomited." The vitamin-D intake also is large in the great majority of children because, as mentioned above, vitamins A and D are taken together. And if the vitamin A and D intake should depend on the economic or social condition of the child's family, we would expect fewer myopic patients in our private practice and a preponderance of the myopic in the clinics. But this is not the case! No matter how we approach the question, we cannot say that the myopic patients have had less than their share of vitamin A or vitamin D and calcium in infancy and childhood, nor can we say that an increase in the intake of these two substances will make myopic subjects less myopic or keep their myopia stationary.

A warning is also in order. In these days of indiscriminate dosing with vitamins, we must remember that excessive dosage of vitamin D in the form of viosterol may be harmful. In this respect, I wish to call attention to an article recently published in the Journal of the American Medical Association on "Hormones and vitamins in cosmetics" by Eller and Wolff.[10] The authors mention symptoms of vitamin-D poisoning following the topical application of vitamin-D ointment to the skin of normal rabbits. They also stress the "close chemical structural similarity between the estrus-producing substances derived from the ovarian follicles, the testis hormones, the carcinogenic hydrocarbons, and a whole series of other biologically important substances such as cholesterol, bile acid, ergosterol, and vitamin D." The authors warn that estrogenic substances indiscriminately used may be carcinogenic, and that vitamin D has a marked chemical structural similarity to some carcinogenic hydrocarbons.

"Human D-hypervitaminosis occurs more frequently in children. Several deaths of children have been attributed to an overdosage of vitamin D." . . . "Bills cites Crimm and Reed, who indicate that in man toxic effects begin to appear when approximately 600,000 international units, or 200 times the ordinary dose (3,000 units), of properly irradiated ergosterol is administered daily over a period of several weeks." Guggisberg (see ref. 10) warns against the overwhelming amounts of vitamins now

* Since this was written, pure vitamin A has become available for clinical use in an oily preparation.

recommended by misguided enthusiasts "because vitamins may favor the development of cancer." In summing up on vitamins, Eller and Wolff state as one of their conclusions that "the ingestion of excessive amounts of vitamin D may produce parenchymatous nephritis, calcification of the kidneys and arteries, and skin eruptions in human beings. Vitamin D is apparently the only vitamin that may cause toxic symptoms in man when given orally." In other words, we must be careful not to use too large an amount of viosterol, and possibly 60 drops daily (12,000 units of vitamin D) is too large a dose when given over a period of years.

Ocular changes experimentally induced in A and D avitaminosis

It is so well known that vitamins A and D can scarcely be separated chemically that in performing experiments on the efficacy of the healing properties of cod-liver oil, Getz (see ref. 10) had to use 1,400 guinea pigs and three different fish-liver oils in which the proportions of A and D varied. He found that cod-liver oil, in which D is present in greater proportion to A than in other fish-liver oils, was the best healing agent.

In vitro experiments by Dolldorf and Rowe (see ref. 10) show that "the addition of vitamin A will maintain the growth of epithelium which is depleted of both vitamins A and D, while vitamin D alone did not maintain this growth." They also demonstrated that vitamin A increases the growth of connective tissue, but vitamin D does not affect the growth rate of connective tissue.

The rachitogenic diet used by Blackberg and Knapp,[11] in their experiments in 1934, consisted of: oatmeal, 360 parts; skimmed milk, 50; refined cotton-seed oil, 15; sodium chloride, 12; yeast, 15; meat, 50; and 5 c.c. of tomato juice.

Blackberg and Knapp fed 8 dogs on this diet and 3 a normal diet. They also stated that some of the controls had the rachitogenic diet plus viosterol, and that other controls were given the regular kennel diet which had proved protective against rickets. Which of the three controls had the viosterol and which the normal kennel diet?

The signs they noted in the eyes of the dogs given the above-mentioned diet were "increased lacrimation, inspissated discharge collected on the margins of the lids, multiple small ulcers mostly in the lower two-thirds of the cornea; a white superficial foamy area 2.5 mm. in diameter developed in the cornea, and also a similar area in the conjunctiva." In one case a large ulcer developed, with corneal staphyloma. The muddy iris described in some of the cases is very likely due to the iritis following on the corneal ulceration. These are just the lesions that are produced in vitamin-A deficiency.

Blackberg and Knapp, in 1937,[6] stated that their dogs, when fed on the above-detailed rachitogenic diet, showed a degenerative process in the sclera and substantia propria of the cornea. They also stated that the epithelial layers of cells in the cornea "became thinned when the dietary deficiency was advanced" and "the surface squamous layer was cornified in some of the animals." The connective tissue of the cornea and sclera and the epithelium of the cornea were primarily affected. These are just the tissues which vitamin A influences, as has been repeatedly demonstrated by many independent investigators, and over which vitamin D has no influence, according to the experiments of Dolldorf and Rowe.

Further proof of the effects of A avitaminosis on ocular tissue is furnished by Mutch and Richards, the abstract of whose article is quoted by Miller[5] as follows: "Mutch and Richards produced keratoconus experimentally as a sequela to acute xerophthalmia in rats on a vitamin-A-free diet. In most cases the cor-

neas regained their normal contour after the animals were given vitamin A for a few weeks. Corneal nebulas and myopia remained as permanent defects. The authors do not suggest that keratoconus is due in every case to avitaminosis A but they do know that, owing to the lack of vitamin A, ocular lesions can be produced experimentally in 100 percent of rats and keratoconus with comparative ease."

These changes have been produced by others repeatedly and we know that lack of vitamin A can do this. Miller also showed that the scleras of rats could be made 18 percent thinner by reducing the vitamin A in the diets of rats.

In order to check on the results recorded by Blackberg and Knapp in connection with their experiments on young dogs, I sent a copy of the diet they used, which I quoted above, to the American Medical Association. The reply by the secretary of the Council on Foods, Franklin C. Bing, was as follows: "The diet for young dogs which you mentioned in your note of May 22d would not provide very much vitamin A. If you are interested in studying vitamin-D deficiency, you would want to have enough vitamin A in the diet, as you have indicated in your note, to avoid difficulties in interpreting your results. I am sending your inquiry, together with a copy of this acknowledgement, to Dr. George R. Cowgill, a member of the Council on Foods of the American Medical Association and one of the outstanding investigators in nutrition in this country. I think that he would be better able than anyone else I know of to reply to your inquiry, and I assume that he will write you directly."

Dr. Cowgill's reply was as follows: "Your letter to the Journal of the American Medical Association inquiring about a dog diet has been referred to me for answer. The diet described is very low in vitamin A. It is now known that most mammalian species require not less than about 100 international units of vitamin A per 100 calories metabolized; this is a minimum, and the needs for excellent growth, reproduction, and lactation are much greater. It would be advisable to see that your animals receive not less than about 300 or 400 international units per 100 calories."

The diet used by Blackberg and Knapp in their experiments on dogs is markedly deficient in vitamin A, and the lesions produced in the eyes of their dogs are exactly those lesions that develop when vitamin A is lacking in the diet. There is no proof that lack of vitamin D was responsible for the ocular changes in their experiments.

Procedure recommended in treating myopia

In treating myopia my usual procedure now is to prescribe the weakest minus lens that gives normal vision in each eye separately, and this is done under 5-percent homatropine (or 1-percent atropine) and 1-percent paredrine cycloplegia. The patient is instructed to use the glasses for reading or other close work and at school (if of school age) but not to wear them otherwise, except at the theater or movies or when distance vision is to be improved, as when driving an automobile. The general health is to be kept at as good a level as possible, and the diet is to be adequate and not deficient in any respect. Reading, sewing, music lessons, and all other close work are to be kept at a minimum compatible with the work the patient has to do.

It is important that the glasses should not be used constantly for distance, as in this way the accommodative effort that is necessary for distance vision will come into play. In my opinion, the contraction of the radial fibers in the ciliary muscle causes a shortening of these fibers, with a resultant pull on the zonular fibers, in

this way causing a flattening of the lens. This will tend to focus the light rays nearer to the retina, as the radial fibers accommodate for distance. If the correction is worn for distance, the radial fibers of the ciliary muscle will not contract but instead will atrophy.

When the glasses are worn for near work the circular fibers of the ciliary muscle contract in the act of accommodation for near. In this way we tend to keep the ciliary-muscle fibers active and prevent their atrophy.

Since using this procedure, I have been quite satisfied with the progress of my myopic patients. They are able to accustom themselves to their vision for distance without glasses except, as stated above, for the movies and the theater, and like usage. The increase in myopia seems in some patients to be in proportion to the amount of close work, in others it seems to have no connection. And I have yet to see at my office a patient whom I have followed since his childhood whose myopia has continued to increase in amount after the age of 22 years. Nor have I seen any eyes continue on to posterior staphyloma and the associated changes of severe progressive myopia.

Conclusions

1. There is experimental proof that A avitaminosis will cause changes in the ocular tissues of experimental animals primarily in the cornea and sclera.

2. There is insufficient proof that D avitaminosis *alone* will cause changes in the cornea and sclera.

3. Infants and children in New York City get sufficient amounts of vitamins A and D, and this is true of those children coming from poor homes as well as from the well to do.

4. Excessive dosage of viosterol has caused unhappy results in children, and excessive dosage of viosterol in adults may be carcinogenic in effect.

5. Myopic persons should not constantly wear their correction for myopia for distance vision unless vision without the glasses is so poor that the wearing of glasses is absolutely necessary. But the myopic must wear their correction for close work always.

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Bibliography

[1] Carroll, F. D. Importance of diet in the etiology and treatment of tobacco-alcohol amblyopia. Arch. of Ophth., 1937, v. 18, Dec., no. 6, p. 948.

[2] Johnson, L. V. Alcohol-tobacco (toxic) amblyopia treated with thiamin chloride. Arch. of Ophth., 1939, v. 21, April, no. 4, p. 602.

[3] Levine (Laval), Joseph. Pellagra as a cause of optic neuritis. Arch. of Ophth., 1934, v. 12, Dec., no. 6, p. 902.

[4] Gamble, R. C. Keratomalacia and involvement of pancreas. Amer. Jour. Ophth., 1940, v. 23, May, no. 5, p. 539.

[5] Miller, H. Is myopia a deficiency disease? Amer. Jour. Ophth., 1940, v. 23, March, no. 3, p. 296.

[6] ———. Vitamin-D–calcium-phosphorus complex. Amer. Jour. Ophth., 1937, v. 20, April, no. 4, p. 405.

[7] Laval, Joseph. Vitamin D and myopia. Arch. of Ophth., 1939, v. 19, Jan., no. 1, p. 47.

[8] Knapp, A. A. Vitamin-D complex in progressive myopia. Amer. Jour. Ophth., 1939, v. 22, Dec., no. 12, p. 1329.

[9] Lewis, J. M., and Haig, Charles. Vitamin A requirements in infancy as determined by dark adaptation. Jour. Pediat., 1939, v. 15, Dec., no. 6, p. 812.

———. Vitamin A status of children as determined by dark adaptation. Jour. Pediat., 1940, v. 15, March, no. 3, p. 285.

[10] Eller, Joseph, and Wolff, Shirley. Hormones and vitamin D in cosmetics. Jour. Amer. Med. Assoc., 1940, v. 114, May, 11, no. 19, p. 1865 and May 18, no. 20, p. 2002.

[11] Blackberg, S. N., and Knapp, A. A. Ocular changes accompanying disturbances of calcium-phosphorus metabolism. A preliminary study. Arch. of Ophth., 1934, v. 11, April, no. 4, p. 665.

THE SIGNIFICANCE OF STURM'S INTERVAL IN REFRACTION*

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The phenomenon of Sturm's astigmatic interval has long been known in the field of physiologic optics. So far as I know, however, very little concerning its clinical application to the problems of refraction has been taught. One of the main difficulties in refraction is the diagnosis, interpretation, and treatment of astigmatism. The phenomena exhibited by Sturm's astigmatic interval illustrate a fundamental theme in the problems of astigmatism. I have referred to this theme in a previous paper.† The ability of the ophthalmologist to keep clearly in mind a picture of the phenomena of Sturm's interval is of the greatest aid to an understanding of the various problems which arise in treating astigmatism.

Sturm's interval (fig. 1) is the distance represented in the conoid of Sturm between the two focal lines of the two principal planes of an astigmatic lens system. As rays of light pass through an astigmatic lens system they come to a focus at each of these two principal focal distances. In the interval between these two focal lines there is formed a series of imperfect or distorted images of the object or source of light, and these images are representative of the images seen by an astigmatic eye when it is viewing an object. One of these distorted images is more nearly perfect than the rest and is called the "circle of least confusion" (fig. 1 *4*). It is situated near the middle of the interval.

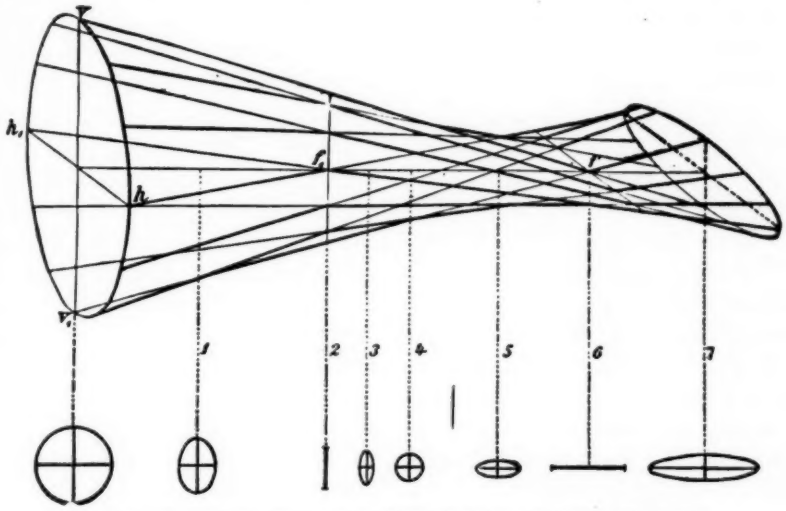

Fig. 1 (Prangen). Sturm's astigmatic interval (after Fuchs).

The clinical problem in astigmatism is to replace these distorted images of Sturm's interval with a corrected image by obliterating the interval by means of correcting lenses; in other words, to bring the two principal focal lines together. This would be a full correction of astig-

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†Prangen, A. DeH. Some problems and procedures in refraction. Arch. of Ophth., 1937, v. 18, Sept., pp. 432-447.

matism, an ideal situation which it is not always possible or feasible to achieve, as will be discussed later.

The concept of Sturm's interval is an aid to understanding the optics of astigmatic lens systems or astigmatic eyes. It aids in visualizing how and what astigmatic eyes see, whether they be uncorrected, partially corrected, overcorrected, or fully corrected. It visualizes for ophthalmologists what is occurring in the patient's mind's eye, and also what is occurring as a result of the ophthalmologist's manipulations when he attempts to correct astigmatic eyes by subjective methods; that is, by lenses and cross cylinders. When the ophthalmologist is subjectively refracting astigmatic eyes with lenses or cross cylinders, he is progressively shifting or changing the images of the interval as seen by the patient's eyes, and attempting to find a combination of lenses that will obliterate the interval; in other words, he attempts to find a lens combination that will bring the two principal focal lines to the same plane and produce a correct image of the object that is being looked at.

If the patient's eye can be made to accept the fully corrected image with comfort, the situation will be excellent. Astigmatic eyes may or may not do this. When they are satisfactorily relaxed by a cycloplegic, most eyes will do this, for they have little opportunity to do otherwise when the accommodation is suspended. With manifest, fogging, or at postcycloplegic examinations, however, these eyes, as is well known, often refuse to accept full astigmatic corrections. Since many eyes are accustomed to vision with an uncorrected and distorted image situated somewhere in Sturm's interval, astigmatic eyes often resist stubbornly the ophthalmologist's attempt to substitute a new image, even if it is more nearly accurate and correct than the old one. Such eyes function tenaciously according to the old image to which they are accustomed and resist the substitution of a new image. I am referring, of course, to those adult astigmatic eyes in which the astigmatism has never been corrected. Youthful eyes usually will accept full astigmatic correction, as will also those older eyes which have already become accustomed to partial astigmatic correction.

If a clear understanding of Sturm's interval is borne in mind, it is possible readily to comprehend the marked variation in subjective acceptance by these astigmatic eyes when the accommodation is active, as contrasted to the situation obtaining when the accommodation is suspended. When the accommodation is active, there is a constant shift or change occurring in the nature and character of the images in the interval. This changing state naturally interferes with accurate subjective refraction. This variation in the subjective acceptance of correcting lenses applies likewise to presbyopic eyes, for at no time in the presence of presbyopia is the accommodation entirely inactive. Therefore, presbyopic astigmatic eyes can readily refuse part or all of an astigmatic correction in favor of their old, accustomed, uncorrected image. To use a figure of speech, this image is to presbyopic astigmatic eyes as is an old friend or shoe to some persons; it is perhaps not of the best but the eyes are accustomed to it.

The employment of the cross cylinder for determining the amount and axis of astigmatism is a method of producing a quick and marked shift of sharply contrasted images in Sturm's interval of astigmatic eyes—first in one direction of the interval and then in the opposite direction. The patient is given a choice as to which of these two new markedly different images is the sharpest and clearest, distorted though the images may be. The use of the cross cylinder is a play on the interval of Sturm. If Sturm's astigmatic interval is kept in mind, it will help

greatly in an understanding of the use of the cross cylinder and the interpretation of its results. When the cross cylinder leads the ophthalmologist astray in a determination of the amount of the astigmatism present, it usually does so because the spherocylindrical relationship is not correctly balanced and because a change of sphere is needed instead of an alteration in the cylinder. This error in cylinder-strength acceptance is a phenomenon of Sturm's interval. In using the cross cylinder to determine strength of cylinder, the ophthalmologist should keep in mind the fact that the cross cylinder affects both the sphere and the cylinder. Visualization of the dual optical effect of the cross cylinder by the examiner as he uses this device is most helpful, and aids in avoiding the pitfalls that arise during its use. An incorrect spherocylinder combination causes a distortion of Sturm's interval, and the patient may be forced to elect cylindrical change when in reality the sphere should be altered. Unless the sphere is correct the patient is forced to decide between two images occurring in an artificially exaggerated interval. When the proper sphere is employed, a normal-interval relationship is created and is ready for correction by the true cylinder. This same theme probably accounts for the selection of wrong axes by the cross cylinder when the spherocylindric relationship is incorrect.

In general, it may be said that, when astigmatic eyes are not corrected or will not accept full astigmatic correction, the image of the circle (fig. 1, *4*) of least confusion on the retina, or close to it, is the one most acceptable to them. This image is more acceptable because it is least distorted, which explains why many simple astigmatic and equal mixed astigmatic eyes see so well, about 6/10, without correcting lenses. Their circle of least confusion is already close to the retina. For example, this would be true of an eye with a refractive error of −.75 D. sph. ⊂⊃ +1.50 D.cyl. ax. 90°. Such was the situation in case 1 of the series to be presented here.

It is often advisable to provide the eye with a compromise image, or with partial correction for the astigmatism, by partially obliterating the interval or by bringing the focal lines closer together instead of completely together. In initial attempts to correct higher degrees of astigmatism, the eye, being accustomed to a distorted image or wide interval, may accommodate itself more readily to a gradual adjustment of the interval by partial or compromise corrections of the astigmatism, gradually accommodating itself later to full correction. There seems to be no logical reason why all eyes should be required to adjust themselves to immediate full correction of astigmatism. The patient and the ophthalmologist often will be much happier if the astigmatism is corrected gradually over a period instead of at once. The tendency of American ophthalmologists—myself included—is to insist on full correction for astigmatism as a routine measure. In the case of young persons and of those already provided with partial correction, this procedure works well; but in the case of older persons who are unaccustomed to correction for astigmatism there are, I believe, many whose astigmatism should be corrected partially and gradually, for the reasons just mentioned.

I know of no rule by means of which the ophthalmologist can ascertain how much to deduct when the full astigmatic error is known and when he wishes to correct it partially. This is a point that the ophthalmologist must decide for himself. There is, however, a rule governing spherical and spherocylindric equivalents of formulas for the correction of astigmatism that is a great help. The spherical equivalent to any spherocylindrical formula is equal to the value of the spherical lens plus half the value of the cylindrical lens, added algebraically.

There exists, therefore, a series of equivalent formulas for any given formula for the correction of astigmatism. If the cylinder is reduced by any given amount, half of this reduction should be added algebraically to the existing sphere. This furnishes or gives a formula that is equivalent in visual effect to the original formula. This original formula and all equivalent formulas keep the circle of least confusion or area of best vision in the uncorrected interval, focused on or close to the retina. In other words, the eye is kept an equal mixed astigmat with the two principal focal lines equidistant from the retina. Of course, the farther the focal lines are from the retina, the larger will be the circle of least confusion, and, consequently, the lower the vision will be with each reduction of cylinder. By trial of a series of cylindric reductions in their equivalent formulas, one formula can be found which will provide the patient with vision comparable to full correction. This procedure is, of course, based on another variation of Sturm's interval. The patient is allowed to select a compromise formula, or an image which obliterates the interval partially instead of fully. This procedure provides the eyes with a new image that is not too unlike the image to which it has been accustomed. The image represented by full astigmatic correction may be so different from the accustomed image that the patient's mind's eye will not accept it. For eyes that have difficulty in accepting full astigmatic correction. I have found it better to use these equivalent formulas rather than merely to reduce the cylinder and make no change in the sphere.

The ophthalmologist will also find it helpful to form the habit of thinking in terms of equivalents when he is comparing and evaluating lenses and formulas. Often, when lenses worn by a patient are compared with the ophthalmologist's findings they appear to differ. Closer examination, however, may disclose the fact that they are equivalents, and that the one may be as useful to the patient as the other. As an example, in the consideration of equivalent formulas, the full acceptance with a manifest test or a postcycloplegic test could be: for the right eye a −2.00 D.sph. ⊂⊃ +5.00 D.cyl. ax. 90°. The patient may be 39 years old and may never have worn glasses. The equivalent formulas are:

(1)	−2.00 D.sph.	⊂⊃	+5.00 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(2)	−1.75 D.sph.	⊂⊃	+4.50 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(3)	−1.50 D.sph.	⊂⊃	+4.00 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(4)	−1.25 D.sph.	⊂⊃	+3.50 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(5)	−1.00 D.sph.	⊂⊃	+3.00 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(6)	−0.75 D.sph.	⊂⊃	+2.50 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(7)	−0.50 D.sph.	⊂⊃	+2.00 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(8)	−0.25 D.sph.	⊂⊃	+1.50 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(9)	0 D.sph.	⊂⊃	+1.00 D.cyl. ax. 90°	= equivalent	+50 D.sph.
(10)	+0.50 D.sph.		0 D.cyl.	= equivalent	+50 D.sph.

Equivalent = sphere + ½ cylinder (added algebraically)

On testing these formulas, nos. 3, 4, or 5 are likely to be accepted, with the resultant vision being comparable to full correction. One formula, preferably no. 5, may well be worn with comfort by the patient. A high degree of mixed astigmatism was selected for illustrative purposes, because it shows perhaps the theme of equivalent reduction more strikingly than do other types of astigmatism. High degrees of either compound myopic or compound hyperopic astigmatism may be equivalently reduced in the same manner.

Equivalent reduction of cylinders is most useful in mixed astigmatism and myopic astigmatism and less so in hyperopic astigmatism. In the presence of hyperopic astigmatism in younger persons, if the cylinder is reduced, the active accommodation may make up or balance the spherical component in a reduced formula.

I do not advocate routine partial correction for astigmatism. In selected troublesome cases, however, it is helpful partially to correct the astigmatism, especially when the correction is performed in the manner previously described.

Report of cases

Case 1. A woman, 47 years old. Her visual condition was an example of equal mixed astigmatism that had provided satisfactory distance vision without making it necessary for the patient to wear glasses. Several refractions had disclosed the presence of mixed astigmatism which was equal in each eye. The patient's vision for distance was O.D. 6/10 and O.S. 6/15+ without correction. Cycloplegic refractions had shown her refractive error to be O.D. —1.00 D.sph. ⊂ +2.00 D.cyl. ax. 90° with distance vision of 6/6, and O.S. —1.00 D.sph. ⊂ +2.00 D.cyl. ax. 100° with distance vision of 6/6. She had never felt the need for distance lenses and had never worn them. More recently she complained of presbyopic symptoms, and it was necessary to add +1.00 D.sph., both eyes, to her distance correction in order to provide satisfactory near vision. Having no desire for distance lenses, she was given a correction for near vision only.

In this patient is seen an instance of equal mixed astigmatism in which the circles of least confusion were naturally at focus on the retinas. The patient was content with her equivalent distance vision and sought relief only for presbyopia. She was made comfortable when given full spherocylindrical correction for presbyopia. It was not necessary to reduce the cylinder.

Case 2. A man, aged 55 years, came to the clinic complaining of poor near vision. He was wearing O.D. +3.00 D.sph. with distance vision of 6/12, and +2.25 D.sph. added in the bifocal; O.S. +2.50 D.sph. with distance vision of 6/12, and +2.25 D.sph. added in the bifocal. Near vision, especially in the left eye, was poor. Manifest refraction showed: O.D. +3.50 D.sph. ⊂ +.25 D.cyl. ax. 180° with distance vision of 6/5 and near vision of 14/21, with an addition of +2.25 D.sph. Manifest refraction showed O.S. +3.25 D.sph. ⊂ +2.00 D.cyl. ax. 165° with distance vision of 6/6 and near vision of 14/24, with +2.25 D.sph. added. Full correction was prescribed for the right eye, including a bifocal lens. For the left eye it was thought best to reduce the cylinder by one half; that is, to +1.00 D.cyl. ax. 165°. One half of this reduction—that is, +.50 D.—was added to the original sphere, +3.25, making the new sphere +3.75. By this equivalent reduction and change of both sphere and cylinder the prescription was +3.75 D.sph. ⊂ +1.00 D.cyl. ax. 165°, which gave vision for distance of 6/7 instead of 6/6, which had been the full correction, and bifocal of +2.25 D., which gave near vision of 14/24, the same as it had been under full correction. The patient wore these glasses with comfort for a year, and was then given full astigmatic correction for both eyes. It is believed that he was more comfortable in his initial correction with partially corrected astigmatism for the left eye.

Case 3. A woman, aged 42 years, whose complaint was of poor near vision, or presbyopia. Her visual condition was an example of compound myopic astigmatism with equivalent reduction of cylinder in her first bifocal lenses. The lenses she was wearing showed: O.D. —2.50 D.sph. ⊂ —2.25 D.cyl. ax. 30°, with distance vision of 6/20 and near vision of 14/28; O.S. —1.25 D.sph. ⊂ —2.25 D.cyl. ax. 147°, with distance vision of 6/15 and near vision of 14/28. Cycloplegic refraction, carried out with the aid of homatropine, showed: O.D. —4.00 D.sph. ⊂ —3.25 D.cyl. ax. 35°, with 6/12+ distance vision, and O.S. —1.50 D.sph. ⊂ —3.25 D.cyl. ax. 150° with 6/7 distance vision. Postcycloplegic examination showed acceptance of full correction with the same axes and distance vision, for near vision adding +2.00 D.sph., in both eyes with 14/24 vision in both eyes. Since these lenses would be her first bifocal lenses, and since she was a high-strung, nervous person, it seemed best partially to correct the astigmatism, thereby making it easier for her to adjust herself to her new glasses. The cylinder was reduced by —1.25 D. in both eyes, and one half of this reduction, approximately —.50 D., was added to the original sphere in both eyes. The final prescription was: O.D. —4.50 D.sph. ⊂ —2.00 D.cyl. ax. 35°, with distance vision of 6/12+, a bifocal addition of +2.00 D.sph., with 14/28 near vision, and O.S. —2.00 D.sph. ⊂ —2.00 D.cyl. ax. 150°, with distance vision of 6/7—, and bifocal addition of +2.25 D.sph., with 14/24 near vision. It was observed that both distance and near vision were practically equal with both the full and the reduced equivalent formulas.

Case 4. A man 21 years old. This was an instance of marked mixed astigmatism in a young person who had never worn glasses.

Distance vision was: O.D. 6/30 and O.S. 6/20 and near vision was 14/24 in both eyes, with accommodative near points of 16 cm. Refraction under homatropine cycloplegia gave O.D. —1.25 D.sph. ⊂ +3.25 D.cyl. ax. 100°, with 6/10+ distance vision, and O.S. —3.75 D.sph. ⊂ +4.25 D.cyl. ax. 85°, with distance vision of 6/10+. Postcycloplegic examination gave acceptance of full cycloplegic findings with the same vision as before. Inasmuch as these were the patient's first glasses, it was considered best partially to correct the astigmatism. After trial of several equivalently reduced formulas, vision most comparable to that given by full correction was found when the cylinders were reduced by +1.75 D. in the right eye and by +2.00 D. in the left eye. One half of this reduction was added algebraically to the postcycloplegic spheres, resulting in a prescription of O.D. —.50 D.sph. ⊂ +1.50 D.cyl. ax. 100°, distance vision of 6/12, and O.S. —2.75 D.sph. ⊂ +2.25 D.cyl. ax. 85°, or transposed, —.50 D.sph. ⊂ —2.25 D.cyl. ax. 175°, distance vision of 6/12. Near vision with this reduced correction was satisfactory. It is seen that the difference in distance vision with full and with reduced correction is only one line on the test chart.

Case 5. A man, aged 40 years, complaining of poor vision for distance, and headaches. This was an instance of mixed astigmatism and antimetropia in a middle-aged man who had never worn glasses. Distance vision was O.D. 6/20— and O.S. 6/60—. Refraction under homatropine cycloplegia showed O.D. +1.00 D.sph. ⊂ —3.25 D.cyl. ax. 180°, with distance vision 6/7, and O.S. —1.75 D.sph. ⊂ —3.00 D.cyl. ax. 180°, with distance vision of 6/10—. Postcycloplegic examination showed acceptance of O.D. —3.25 D.cyl. ax. 180°, with distance vision of 6/7, and O.S. —2.50 D.sph. ⊂ —3.00 D.cyl. ax. 180° with distance vision of 6/7. Near vision with correction was 14/21 in both eyes and good range. Inasmuch, as stated, as these were to be the patient's first glasses, at the age of 40 years, it was deemed best to reduce the cylinders. A trial of several reduced formulas showed vision comparable to that obtained with full postcycloplegic correction, when the cylinders were equivalently reduced by —1.50 D. One half of this reduction of cylinder was added algebraically to the postcycloplegic spheres. The prescription was O.D. —.75 D.sph. ⊂ —1.75 D.cyl. ax. 180° with distance vision of 6/10, and O.S. —3.25 D.sph. ⊂ —1.50 D.cyl. ax. 180°, with distance vision of 6/12+. Again it is seen that the vision with equivalently reduced formulas is but one line less on the test chart than that obtained with full correction.

SUMMARY AND CONCLUSIONS

The phenomena incident to and illustrated by Sturm's astigmatic interval have a broad and varied clinical application to the problems of astigmatism in refraction. By visualizing or keeping in mind these phenomena of Sturm, the ophthalmologist is aided in his work. Such visualization makes refraction a much more vital procedure and a much less routinely mechanical process. The employment of equivalently reduced formulas is most useful for astigmatic eyes, concerning which difficulty is anticipated in the patient's wearing fully correcting cylinders. Partial correction of astigmatism is advocated only for such selected eyes as those in which the adaptation to full correction is likely to be difficult.

DISCUSSION

DR. W. B. LANCASTER: I wish to add a word of approval for Dr. Prangen's insistence on the importance of the conoid of Sturm. The experience of the American Board of Ophthalmology shows that the candidates who come up for examination do not understand astigmatism. For example, they do not understand the use of astigmatic charts, for they have not been taught. I am, therefore, addressing myself especially to the teachers and the heads of departments who are members of this society.

What would Dr. Prangen and others who discuss this paper say to the student who brings Gullstrand's statement to their attention? If they read Helmholtz's "Physiological optics," which every student should be required to read, they will discover that Gullstrand says: "The path of the rays in the human eye does not even approximate the conoid of Sturm."

What are the reasons for Gullstrand's statement that the astigmatic eye does not correspond to the conoid of Sturm? The reason is that the eye has so many aber-

rations. Here is the simplest aberration of the spherical lens: The axial rays—those adjacent to the axis of the lens—come to a focus here (illustrating) and the marginal rays come to a focus at a distinctly different point nearer the lens. Sturm takes no account of that. The formulae of Sturm, and those of most of the writers on theoretic optics, are valid for an infinitely small area at the very center of the lens. They take no account of the peripheral rays. The human eye, of course, must take care of the rays in the whole area of the pupil; hence students should be taught the practical application of spherical aberration, especially with dilated pupils.

In asking my question I should give my own answer, which is that the lenses which we use to correct errors of refraction—spheres and cylinders—refract light precisely according to the conoid of Sturm, and therefore the best we can do in correcting errors of refraction is to use these simple regular lenses, selecting that combination which corrects the largest possible part of the mixed errors of the eye. Students could make these experiments on one another and on themselves, and so study the effect of the different lenses on the image.

I should like to show the effect of accommodation on the conoid of Sturm as demonstrated by the projection lantern: First, the image of a "point" of light is projected on the screen, appearing as a tiny luminous dot; next a cylindric lens is inserted in front of the projection lens of the lantern. This changes the image of the "point" to a line—a luminous line; next, instead of the point, a slide with two lines at right angles is inserted—first without the cylinder (a sharply defined image of the lines is thrown on the screen); second, with a −0.25 D. cylinder in front of the projection lens, with its axis parallel to one of the lines. Now one line remains sharp, because every point in it is a narrow line parallel to the line itself. The other line is blurred, because every point of it is imaged as a line at right angles to the line itself. What I wish to demonstrate is the effect of accommodation on this image of one sharp line and a very much blurred line at right angles to it. As the lantern operator focuses the instrument a point where both lines are alike is found. There is no visible astigmatic effect. Of course, the lantern lens system can change its focuse only as a whole—not more in one meridian than in another. In other words, there is no possibility of what is called in the eye astigmatic accommodation—greater action of the ciliary muscle in one meridian than in another, thus compensating or correcting the astigmatism by an unequal contraction of the ciliary muscle. The neutralization of the astigmatism must be accomplished in another way, as it is by so focussing the lantern that the image is at the interfocal circle of the conoid of Sturm. The lines are all alike, but all are slightly blurred.

Lastly, a slide showing an astigmatic dial is inserted first without the —0.25 D. cylinder—all the lines are clear and equal; next, with the —0.25 D. cylinder—now a small group of lines is clear, whereas the others are blurred. If the cylinder is rotated, the group of clear lines is rotated, showing how easy it is to locate the axis of the cylinder. If a +0.25 D. cylinder were inserted with its axis parallel to the −0.25 D. cylinder, all the lines would be alike again. Without adding a + cylinder to neutralize or correct the −0.25 D. cylinder, but merely by focussing (accommodating), all the lines are made absolutely equal but slightly blurred.

The importance of this clinically is very great. It has never been demonstrated that unequal accommodation is a function of the normal eye. The normal eye neutralizes astigmatism by normal

accommodation. The latter is best prevented by fogging, since this avoids the confusing and misleading aberrations introduced when the pupil is widely dilated. It is to be regretted that this art is not more widely taught.

DR. ALFRED COWAN: In teaching optics at the University of Pennsylvania we always endeavor to show how the theory of optics may be applied to our everyday practical work. The students do the experiments themselves and, having actually set up an optical system on a bench, they are able to visualize Sturm's concoid and know exactly what it means. They must realize that Sturm's concoid is a figure composed of a series of diffusion images of a point object by a spherocylindric optical system. In such a figure as we have here the first focal line by the refraction of one meridian of this system, and the second focal line at the focal distance of the other meridian, are at right angles to each other. Between these two lines we have what is commonly known as the circle of least confusion. The distance between the two focal lines indicates the amount of astigmatism of the two systems. If they coincide, there will be no astigmatism, therefore, the greater the distance between the two focal lines, the greater the amount of astigmatism. The circle of least confusion is not a circle except when the aperture is a circle, so that the term "circle of least confusion" applies only to a system which has a circular aperture. If the aperture were square, the diffusion image at this place would be square. However, in every system of this kind every image is a diffusion image. There is no point image of the object point anywhere in the system. In applying this to the eye we may place the retina here, there, or anywhere, and, depending on where we place it, we have a given type of astigmatism; simple hypermetropic astigmatism if it were at the first focal line, myopic astigmatism behind the second focal line, compound hypermetropic astigmatism in front of the first focal line, and mixed astigmatism between the two focal lines.

What do we accomplish with lenses? We may shift the whole figure with spherical lenses, bringing it forward or backward. When we use spherical lenses, the distance between the two focal lines which indicates the amount of astigmatism is never affected. Only a cylindric lens can approximate or further separate those two lines.

What Dr. Prangen has said about equivalent lenses is important to a certain extent, but only quantitatively, not qualitatively. Quantitatively, we may assume very roughly, the amount of curvature in a two-diopter cylinder approximates the total amount of curvature of a one-diopter sphere, but qualitatively there is no such equivalence as the table indicates. I believe that the first to use these equivalents was Dr. Jackson, who described them in a paper published some time ago. For his purpose it was excellent. A very good example of what I mean is in a cross cylinder. A plus 50 crossed with a minus 50 is nothing but a spherocylinder with a plus 50 and a minus 1 or a minus 50 and a plus 1. If we have a half diopter of sphere of one denomination plotted against a whole diopter of cylinder of the opposite denomination (using the equivalent table), we see that a half diopter of sphere would neutralize exactly one diopter cylinder of the other denomination. Here you have an example of a lens from the equivalent standpoint which is neutral, or probably would be called plano, from the quantitative standpoint, but qualitatively it is still a one-diopter cylinder. It is one of our reasons for using the cross cylinder. When the patient, by accommodation or

otherwise, chooses a point in Sturm's conoid, he chooses a place where there is the least amount of astigmatic distortion. At best he still has a diffusion image of the type which is found with a spherical error. His visual acuity should not be better than would be indicated by the amount of spherical error from the first or second focal line to the circle of least confusion.

In the eye we have a different type of optical instrument from the ordinary ones. We have a dynamic instrument that can change its focal power and select a place for itself. As Gullstrand says, in the eye we have not such a fixation of rays as Sturm's conoid, but a small amount of aberration that would make the lines form a figure so complicated that it can hardly be drawn on a plane surface; but the eye, by its ability to accommodate, chooses the proper place and while it may receive an image that has quite a wide area of aberration around it, by its ability to ignore the peripheral portion of the image and to select and interpret the image, it is still able to see distinctly even with the aberration which Gullstrand has shown.

Dr. F. H. Verhoeff: I shall try to present this situation from a different point of view. I would say that the conception of Sturm's interval is a very important one, and every one who undertakes refraction tests should pass through the stage of this conception. I may say that it represents an embryonic stage in the development of knowledge of refraction of the eye, and some persons never get beyond this embryonic stage. After the conception is thoroughly understood, we must realize to what extent it cannot be applied. To understand certain phenomena, the conception must be modified. To explain certain things, aberrations must be considered in addition. For example, simple spherical aberration combined with astigmatism, when considered in the light of Sturm's interval, will explain many cases of monocular diplopia. Similarly, consideration of aberrations in addition to Sturm's interval is necessary to explain the cases of so-called aphakic accommodation. If we go still further, we must consider also chromatic aberrations, diffraction, and even polarization to explain certain phenomena. We meet this problem in every field. But because we say it is not exactly true, does not mean that the conception is not a most valuable one.

Dr. Edward Jackson: We have had an interesting and instructive discussion of optical theory, but perhaps the subject has not been carried into the realm of ordinary practice. After Sturm and Helmholtz had written their articles, skiascopy was introduced as a means of measuring refraction of the eye. With skiascopy and a dilated pupil, the fact that impresses us most is that the refraction is unequal in different parts of the pupil. Also astigmatism varies in different parts of the pupil, in meridians and in amount. The so-called linear shadows are not lines. They are, rather, areas of light and shadow that move in different direction in different parts of the pupil. These aberrations disappear with a contracted pupil. For that reason subjective refraction of the eyes should be tested in a relatively strong light for the final determination. The ciliary muscle may or may not be completely relaxed. The habits of the patient are to be considered. I find the most useful rule is never to prescribe a spherocylindric correction on one determination, but on another day to make a second determination, starting with what I found before, and correcting the errors I made in my first examination. I have seen one pair of eyes five times before satisfying myself that I have the correction for the contracted pupils

that would be of the greatest service.

Then the obliquity of the glass makes a difference. Sometimes, when a patient asks, "What is astigmatism?" I take a spherical lens and hold it up, perhaps with the sun shining in the window, and get a very small circular image of the sun; then I turn that spherical lens a little obliquely and immediately introduce the interval of Sturm. At one distance you get a vertical line, and at another distance, the horizontal line. That goes on when the patient looks through different parts of his glasses, and it grows worse the larger the glasses are made. The patient looking obliquely will get a different interval of Sturm from that which he will if he were looking exactly perpendicular to the glasses. I advise college and high-school students at the end of the semester, before going up for examinations not to use the eyes constantly for an hour's reading, but for short intervals only, perhaps every minute, and to close the eyes and consider what they have just read, so that the eyes may rest. On first opening them the image is most distinct. At such times we catch the relaxed eye. We see the eye that theoretically we have corrected with the lens; and in this way quickly overcome the difficulties that Dr. Prangen has graphically depicted.

DR. H. M. LANGDON: To all who are practicing ophthalmology this is an important subject, for 75 percent of our work is dependent upon it. There are two points I should like to discuss especially. The first is about Dr. Lancaster's suggestion of the knowledge of the astigmatic dial for the study of the effect of Sturm's conoid as a help to students in refraction. I agree with him, and believe that the astigmatic dial is very useful for students of refraction, but I don't regard the ordinary astigmatic dial as of great service. The dial made by Herbert Ives is the most useful. Take out one grating, however, and use merely the lines. You can arrange this so that the size of the lines is exactly the visual angle of your subject.

The second point I wish to bring out has not been mentioned this morning, and that is the comfort of the patient, for that is one of the things he comes for. He wants to see, and he wants to be comfortable. I tell students at the university that they have not done a successful refraction of the patient unless they achieve good distance vision, a good near-point, and the relief of symptoms. Now as to the partial correction of astigmatism. That depends, I believe, entirely on the conditions that Dr. Prangen has described. There will be only a small fraction of 1 percent that will not take the correction if the error is measured accurately and due allowance is made for the play of the ciliary muscle afterward for changes in the spherical lens. I do not believe in changing the cylinder. As I said, the patient desires comfort. We have seen persons with a 1½ D. of astigmatism with normal vision and a good near-point and no symptoms. There is no reason for urging such patients to wear a correction if they are comfortable without it. The correction of astigmatism depends on the subjective symptoms that are present, and this covers a very wide field.

FUNCTIONS OF RELATIVE ACCOMMODATION

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In the quantitative consideration of phenomena associated with relative accommodation, it is obvious that some particular state of the ocular musculature must be designated as a basic condition. This is customarily assumed, such that, in emmetropia, rays of light from distant objects are sharply focused upon the retina when the accommodation is completely relaxed. Under these conditions the normal eye appears to be incapable of appreciable negative relative accommodation; that is, even a small addition of plus power may blur the vision. Yet it is also known that neural and structural mechanisms are present which might mediate such an accommodative change. According to Cogan,[1] "It appears that the sympathetic system tends to adapt the eye for relatively distant objects and as such opposes the parasympathetic system which tends to adapt the eye for relatively near objects." Cogan also states (1) that the radial fibers adapt one's focus for relatively distant objects and the circular fibers for relatively near objects, (2) that one is just as much an accommodative function as the other, and (3) that they exist in a state of reciprocity similar to that of the dilator and sphincter muscles of the pupil.

Even assuming that the normal adult nonpresbyopic eye is unable to accept plus power at distance, it is still conceivable that the accommodation is not relaxed, as is usually assumed, but rather that negative relative accommodation is already in force in order to secure maximal visibility.[2] It would follow from this hypothesis that the normal eye, in a state of rest but not freed from nervous control, is accommodated for some finite distance. Thus negative relative accommodation, as measured from such a state of rest, may result either from a decrease in parasympathetic or from an increase in sympathetic-nerve excitation. These characteristics of the ocular state of rest might be expected on teleologic grounds. For example, the functioning of the parasympathetic ocular mechanism is associated with subjective fatigue while the latter is not experienced with sympathetic activity. Therefore, it would permit a large part of the activity of the eye to be accomplished without the fatigue associated with parasympathetic functions if the transition from short to long range could be mediated by the sympathetic machinery. It also will be shown that these assumed functions of relative accommodation are in harmony with experimental evidence obtained in the absence of adequate stimuli for relative accommodation and under conditions in which impulses are being received through both sets of nerves.[3]

EXPERIMENTAL PROCEDURES

In the present discussion, the term visibility[2] is used to denote the intensity of a psychophysical stimulus that evokes visual perception and discrimination. This quantity, by definition, depends not only upon the physical characteristics of the object of regard but also upon the efficacy of the visual processes of the observer. If it be specified that all measurements of visibility are to be made with the same test object, the measured quantity then relates to the efficacy of the visual processes of the observer. Thus maximal visibility will be obtained, for

*From the Lighting Research Laboratory, General Electric Company.

example, when the object and the retinae are conjugate. If the refractive power of the system is altered by the addition of ophthalmic lenses, less than maximal visibility (for a given test object) will result unless such additions are accompanied by compensatory accommodative changes.

The relation between visibility and refraction, in the absence of accommodative activity, is determinable with the Luckiesh-Moss sensitometer when the latter is used under certain prescribed conditions. Since this instrument and technique have been described elsewhere,[4] only a brief discussion is included here. The sensitometer comprises two colorless circular photographic gradient filters, precise in optical density and diffusion, which may be rotated synchronously before the eyes of the subject in order to bring a standardized test object to the threshold of visibility. These gradient filters not only alter the apparent brightness of the entire visual field by absorption, but also alter the brightness-contrasts of all objects within the visual field, due to the slightly diffusing character of the filters. Thus threshold conditions are obtained by photometric changes, while the visibility of the test object may be expressed in terms of any one of the fundamental variables of the threshold stimulus.[2] With our instrument, visibility values are read from a calibrated scale attached to the gradient filters. The method of calibrating this scale and its visual significance have been discussed elsewhere.[5]

It has been shown that relative accommodation is preventable through the avoidance of an adequate stimulus for this function.[6] If, in the measurement of visibility, the test object is brought from a subthreshold condition to the threshold of visibility by progressively decreasing the density of the filters through which it is viewed, it follows that there can be no optical stimulus for accommodation until the lowest threshold of visibility, involving the mere recognition of the presence of the test object, is reached. The conditions thus imposed by this procedure are somewhat analogous to those involved in the "fogging" method of refraction except that in our procedures all objects within the entire binocular field (with the exception of an adequately diffuse convergence-target) are obscured by the filters until the threshold of test-object visibility is reached. Since the visibility of the test object itself is higher than that of other details of the visual field, there is no adequate stimulus for accommodation throughout the process of measurement. Obviously, if the refractive states of the eyes are to be determined at finite distances, it is essential to provide a binocular stimulus for convergence which *per se* will not stimulate relative accommodation.[4]

The determination of the relationship between visibility and refraction is made possible by the addition of a convergence-target consisting of a vaguely defined band of diffused light located in the plane of the test object. It has been shown empirically that such a band of light (whose image lies in parafoveal regions) provides an adequate stimulus for convergence but an inadequate one for relative accommodation.[4] This characteristic is exhibited for various modifications of our standardized convergence-target. Hence, trial lenses of various powers may be placed before either eye alone, or before both eyes simultaneously, without altering the inherent interlocking relationship between accommodation and convergence. Thus convergence is the controlled factor in the physiologic situation established by these procedures while the excess or deficiency of the refraction is the measured quantity. Finally, it is a reasonable assumption that normal eyes, under these conditions, are in as complete a state of rest as is possible with the maintenance of accurate convergence.

The essential steps in the sensitometric examination are as follows:

1. A convex cylindrical lens of about two diopters is placed before one eye with its axis horizontal. The purpose of this lens is to obliterate the image of the horizontal test object without impairing the vertical convergence-target, and thus to confine the refraction to the other eye.
2. Spherical or cylindrical lenses of various positive and negative powers are successively placed before the eye under examination, and several measurements of the visibility of the test object (a biconcave bar 60 minutes in length) are made with each.
3. The visibilities obtained with the various trial lenses are plotted as shown in figure 1 and straight lines are drawn through these points. The resultant graph should be symmetrical about the axis of maximal visibility—an indication of the avoidance of accommodation. Its apex indicates the refraction which will produce maximal visibility without the exercise of either positive or negative relative accommodation.

TABLE 1

THESE MEASUREMENTS WERE MADE WITH BINOCULAR FIXATION AT 6 METERS AND WITH THE SUBJECTS WEARING THEIR USUAL CORRECTIONS, IF ANY. THEY ARE THE AVERAGES OF TWO CONCORDANT EXAMINATIONS MADE ABOUT A MONTH APART

	Right Eye diopters	Left Eye diopters
Average for all subjects	−0.76	−0.73
Mean variation of mean for one subject	0.24	0.29
Probable error of general mean	0.05	0.06
Average for 12 subjects with glasses	−0.75	−0.81
Average for 8 subjects without glasses	−0.76	−0.61

Since the same procedures and apparatus are used at all fixational distances, the results are strictly comparable. Hence, anomalies in the accommodation-convergence relationship, if present, are clearly revealed.

An experimental group of 20 subjects, including both men and women, was selected at random from technical and clerical groups for these studies. The subjects ranged in age from about 25 to 35 years and are considered as emmetropic (with corrections, if necessary) from the viewpoint of the usual ocular examinations. The data of table 1 indicate the average additional dioptric power required by these subjects to obtain maximal visibility at distance (that is, to focus the light from a distant object upon the retina) when the accommodation is controlled by the techniques described.

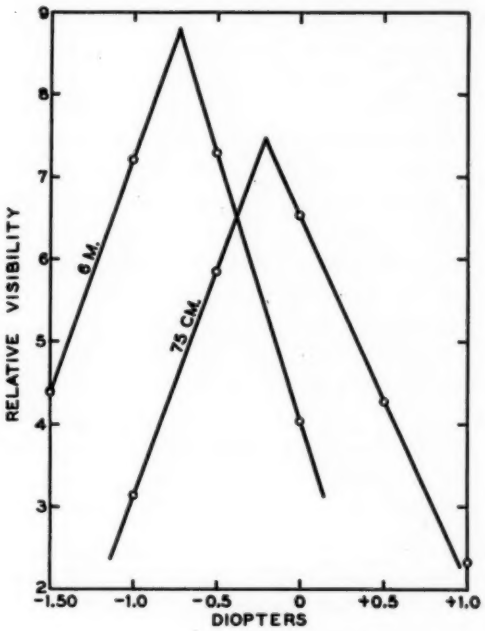

Fig. 1 (Luckiesh and Moss). Relations between visibility and refraction for fixational distances of 6 meters and 75 centimeters as determined by the sensitometric method of examination. The apex of this diagram geometrically coincides with the refraction which will yield maximal visibility.

It will be noted from table 1 that an average of about three fourths of a diop-

ter of negative power is required to produce maximal visibility at distance, when negative relative accommodation is prevented by the technique previously described. Under these experimental conditions, it appears that the focus of parallel rays of light is at a point about three fourths of a diopter anterior to the retina for the typical unaccommodated adult

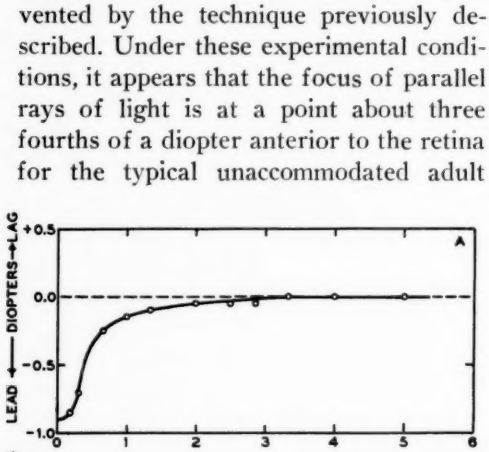

Fig. 2 (Luckiesh and Moss). The refractive state of the eye, in the absence of adequate optical stimuli for accommodation, for various fixational distances as determined for two emmetropic subjects. The horizontal dashed line would represent a perfect functioning of the accommodation-convergence mechanisms at all distances.

emmetropic subject. Briefly, this condition may be described as a "lead of accommodation" at the far-point. Among the individual subjects, however, the indicated lead of accommodation at the far-point varies from about three eighths to 1⅜ diopters.[4] This fact minimizes the possibility that the indicated lead of accommodation is due to some systematic error in the experimental procedures. It also suggests the inadequacy of physiological "constants" in the prescription of ophthalmic corrections. In view of these considerations, it may be postulated that the blurring of distance vision with the addition of plus power to an "emmetropic" eye is due not to the fact that negative relative accommodation is physiologically impossible at this fixational distance, but that this function has been utilized, perhaps to the limit, in compensating for a lead of accommodation.

The existence of a lead of accommodation at the far-point is further supported by the fact that these same subjects were found to be emmetropic, on the average, when examined by the same technique at the usual reading-distance as is shown by the data of table 2. Thus the retina and the near-point test object are conjugate, without compensation by relative accommodation, in the case of the emmetropic, adult, nonpresbyopic subject. But this is not the case in distance vision, since an average of about three fourths of a diopter of negative relative accommodation, as measured from the position of rest, is then required for maximal visibility (table 1). It may also be not without significance from a functional viewpoint that the dynamic* data are less variable than the static* data, as will be noted from the corresponding probable errors of the general means given in tables 1 and 2.

TABLE 2

THESE VALUES INDICATE THE ADDITIONAL DIOPTRIC POWER REQUIRED TO PRODUCE MAXIMAL VISIBILITY WITH BINOCULAR FIXATION AT 40 CM.

	Right Eye diopters	Left Eye diopters
Average for all subjects	+0.02	+0.04
Mean variation of mean for one subject	0.15	0.18
Probable error of general mean	0.02	0.02
Average for subjects with glasses	+0.02	+0.01
Average for subjects without glasses	+0.03	+0.08

* These terms are used to indicate relative fixational distances.

In view of the significance of these results, a detailed study of the accommodation-convergence relationship was made for two of the subjects A and B, for additional fixational distances between 6 meters and 20 centimeters. The results are presented graphically in figure 2. These data represent average values derived from two successive examinations with differences in refraction between the two examinations seldom as great as one-eighth diopter at any distance. Thus the relationships shown in figure 2 may be considered as highly reliable from statistical and clinical viewpoints. In both cases, it will be noted (1) that additional negative lens power is required in order to obtain maximal visibility at all distances greater than about one third of a meter; (2) that the refractive differential decreases abruptly but regularly as the fixational distance decreases from 6 meters to about 1 meter; and (3) that approximate emmetropia is indicated for distances less than 1 meter. These relationships, based upon the attainment of maximal visibility without the exercise of relative accommodation, are in marked variance with those indicated by retinoscopy; and they may shed considerable light upon the use of corrective-factors in dynamic retinoscopy.[7]

In the case of subject B, the deficiency in plus power for fixational distances of the order of 20 centimeters can be described as a "lag of accommodation." It is a characteristic which would be expected to increase in magnitude as the fixational distance is progressively decreased. It may also be assumed that it would increase as presbyopia is approached. Actually both of these subjects were able to obtain maximal visibility through the exercise of either negative or positive relative accommodation over the entire range of distances studied, when adequate stimuli for accommodation were present. Thus these subjects are not handicapped in normal seeing due to the indicated lead of accommodation. On the other hand, it is probable that such a lead augments the efficacy of the individual in shifting from distance to near vision. In all cases studied, it appears that the physiologic state of rest is not coincident with distance fixation for the normal, adult, nonpresbyopic subject. This characteristic is not necessarily a deleterious one since critical seeing at long range is rather infrequent as compared with the demands of near vision. Furthermore, critical seeing at distance is almost invariably associated with activities which themselves require the functioning of the sympathetic mechanism, so that the provision of negative relative accommodation becomes almost automatic.

Accommodative-lead and myopia. The experimental evidence of a lead of accommodation in normal adult subjects suggests, for example, that excessive near work during childhood might unduly develop this physiological function. In such cases, the additional handicap of hyperopia in childhood would augment the accommodation required at close range; and, together, these demands might result in after years in a lead of accommodation too great to be counteracted by the exercise of negative relative accommodation in distance vision when the hyperopia has been reduced morphologically with age. Such a series of events and effects might result in either myopia or pseudomyopia. It is to be expected that any elongation of the anterior-posterior axis of the eye with age would serve to reveal, in such subjects, a myopic condition; that is, an excessive lead of accommodation which presumably developed as compensation for a combination of congenital hyperopia and excessive near-point seeing during childhood.

References

[1] Cogan, D. G. Accommodation and the autonomic nervous system. Arch. of Ophth., 1937, v. 18, p. 739.

[2] Luckiesh, Matthew, and Moss, F. K. Supra-threshold visibility. Jour. Opt. Soc. Amer., 1940, v. 30, p. 62.

[3] ———. Functional adaptation to near-vision. Jour. Exp. Psychol., 1940, v. 26, p. 352.

[4] ———. New method of subjective refraction involving identical techniques in static and dynamic tests. Arch. of Ophth., 1940, v. 23, p. 941.

[5] ———. Visibility—its measurement and significance in seeing. Jour. Franklin Inst., 1935, v. 220, p. 431.

[6] ———. The avoidance of dynamic accommodation through the use of a brightness-contrast threshold. Amer. Jour. Ophth., 1937, v. 20, p. 469.

[7] Sheard, Charles. Dynamic skiametry and methods of testing accommodation and convergence of the eyes. Cleveland Press, 1920, p. 108.

ADVANCES IN THE USE OF SULFANILAMIDE COMPOUNDS IN OPHTHALMOLOGY*

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In the first paper on chemotherapy from the Wilmer Institute, published in 1939, the uses of sulfanilamide compounds in general medicine were summarized and the results of treatment in 43 patients with ocular inflammation were reported.[1] Since that time significant advances have been made in the field of chemotherapy, chief among which are the widespread use of sulfapyridine and the introduction of sulfathiazole. In a recent report from the Wilmer Institute the results obtained with local chemotherapy were evaluated.[2] The present paper brings up to date the results obtained by other authors with the systemic administration of sulfanilamide compounds, and includes a report of the results of chemotherapy in 104 patients with ocular disease treated in the Johns Hopkins Hospital. The 104 patients in this series received no local treatment other than atropine when indicated and argyrol and boric irrigations to cleanse the eyes.

* From the Wilmer Ophthalmological Institute of the Johns Hopkins Hospital and University. Presented before the Pan-American Congress of Ophthalmology, at Cleveland, October 11, 12, 1940.

Action of sulfanilamide compounds

The exact physicochemical actions of the sulfanilamide compounds are as yet obscure, but certain general principles have been established. These drugs act directly upon the infecting organism rather than through the natural defense mechanism of the body; they apparently interfere with the metabolism of the infectious agent, thereby preventing its multiplication and allowing it either to die or to be overcome by the natural defense mechanisms of the host. Lockwood and Lynch[3] have demonstrated that the presence of peptones *in vitro* decreases the bacteriostatic action of sulfanilamide compounds, this indicating that protein-degeneration products may interfere with the bacteriostatic action of sulfanilamide. It is a matter of common clinical observation that in a localized infection with actual tissue necrosis (and consequently an abundance of "peptones") the effect of a sulfanilamide compound is less than it is in a widely disseminated infection without tissue damage; it is usually necessary to drain an abscess before the infection can be eradicated by the use of sulfanilamide.

The effects of sulfanilamide compounds against bacteria *in vitro* appear to be similar to the effects of these compounds in the living body. This is helpful in evaluating the relative efficiency of two or more of these drugs against the same strain of bacteria, and offers a means of determining the best drug to use against a given infectious agent without extensive clinical trial.

Dosage

The fundamental principle of chemotherapy is the administration of the drug in dosage sufficient to maintain optimal blood concentrations. The formula for calculating the dosage of sulfanilamide or sulfapyridine necessary to attain given blood levels has been previously reported. For the sake of convenience a simple dosage scheme is tabulated in the appendix. Judging from reports in the literature, there appears to be a tendency among ophthalmologists to be ultraconservative with regard to dosage. As a matter of fact a somewhat higher dosage than that given in the appendix should be used in any infection so acute it threatens a patient's life. This table, however, gives a dosage adequate to maintain an average blood level of between 6 and 11 mg. percent in the case of sulfanilamide, slightly less in the case of sulfapyridine, and between 3 and 9 mg. percent in the case of sulfathiazole. These levels are adequate for the usual ocular infections in which chemotherapy is indicated, and represent the maximum levels that can be maintained with reasonable safety in ambulatory patients. In employing the dosages listed in the appendix it is important to have the patient drink plenty of water (about 2,500 c.c. per day for adults). Actual blood levels must be determined in the event there is renal damage, to guard against an undue retention of the drug.

Toxic reactions

Sulfanilamide, sulfapyridine, and sulfathiazole give serious toxic reactions with approximately the same frequency. The various reactions usually encountered and their significance are summarized in the appendix.

Systemic chemotherapy of ocular infections

The most important sulfanilamide compounds in use at present are sulfanilamide, sulfapyridine, and sulfathiazole. The following survey brings up to date the results obtained with these preparations in the treatment of eye infections in the Wilmer Institute.

Gonococcal conjunctivitis. In the first report it was stated that with adequate chemotherapy nearly all patients with gonococcal conjunctivitis exhibit a clinical and bacteriological cure within one to four days. This statement was based on 13 reports in the literature. Five subsequent reports[4, 5, 6, 7, 8] have more or less substantiated this conclusion. The results of such treatment in a number of patients in the Johns Hopkins Hospital have been uniformly excellent. However, it is now known that sulfapyridine is more effective than sulfanilamide against almost all strains of gonococci, and recent evidence indicates that sulfathiazole is even more effective than sulfapyridine. Two cases of gonococcal conjunctivitis encountered in this hospital were resistant to sulfanilamide but cleared promptly with sulfapyridine.

Sulfapyridine is now used routinely in this clinic for gonococcal conjunctivitis, and is given in approximately the dosage indicated in the appendix. In the first report, it was stated that in order to insure against recurrences it was probably necessary to continue chemotherapy for about 10 days after the first negative smear. Subsequent experience indicates that a

10-day period of aftertreatment is unnecessary; if an adequate blood level is maintained, it is not necessary to continue the drug more than 3 days after obtaining the first negative smear.

Trachoma. Several of the statements made in the first report with regard to the treatment of trachoma appear overoptimistic in the light of further experience and must be partially retracted. However, it is certainly still true that sulfanilamide has completely changed the prognosis of this disease.

Heineman,[9] Lian,[10] and others in the Dutch East Indies used one of the sulfanilamide compounds in very small doses (sufficient to produce a blood concentration of only about 1 mg. percent) in the treatment of trachoma, and noted a very beneficial effect; but they found it necessary to employ additional therapy, such as grattage, in most patients to take care of the follicles. Loe[11] in this country independently treated a large number of trachoma patients with a dosage sufficient to maintain a blood concentration of probably 3 or 4 mg. percent, and reported 100 percent cures, no other form of treatment being necessary. Essentially the same results were reported by Gradle,[12] by Kirk and his co-workers,[13] and by Richards and his co-workers.[14] Hirschfelder,[15] however, observed no effect on the follicles of early cases, and Julianelle[16] and his co-workers later obtained relatively poor results in 113 patients with all types of trachoma, still using the arbitrary and relatively low dosage used by Loe. In brief, Julianelle reports that only 20 percent of his cases were cured and an additional 40 percent improved, the best results being obtained in long-standing cases with exacerbations. Spining[17] thought the results obtained in his small series were due principally to an effect of the drug upon secondary infection. In Julianelle's series, however, the cases without secondary infection were benefited as frequently as those with secondary infection, and the results leave little room to doubt that sulfanilamide has a direct effect on the trachoma virus. Thygeson[18] reported that in 31 cases of trachoma treated with sulfanilamide 16 patients were healed, 11 showed satisfactory improvement, and 4 with late cases exhibited little or no change. In the 11 cases classified as "improved" a certain amount of residual conjunctival inflammation persisted, but this was thought probably to be the result of other factors, such as secondary infection and trichiasis. Thygeson believes that a treatment period of two weeks with a blood concentration of 5 mg. percent or higher is sufficient to arrest trachoma, while low-dosage treatment, maintaining an average blood concentration of 3 mg. percent, requires about five weeks to effect a cure. Both Julianelle and Thygeson found that inclusion bodies invariably disappear during the first several days of therapy. Almost all authors agree that active corneal lesions respond to sulfanilamide more rapidly than do conjunctival follicles.

The answer to the somewhat different results obtained by different observers in the treatment of trachoma appears to depend on two factors. In the first place, it is often difficult to grade "improvement" or "arrest" of the disease, and still more difficult to judge whether or not there is mild recurrence. For example, what Thygeson classifies as "residual conjunctival inflammation due to secondary factors" might be considered evidence of an active trachoma by another author. In the second place, the dosage and the spacing of the daily dosage has varied in the different series. Julianelle conducted a "repeat" experiment, duplicating Loe's dosage, spaced only during the daytime (it is necessary to give sulfanilamide dur-

ing the night as well as during the day to maintain an even blood concentration), while Thygeson used higher dosage in many of his patients and controlled the blood levels by actual determinations.

Trachoma is encountered comparatively rarely in Baltimore, and to date only 13 trachoma patients have been treated with sulfanilamide in the Wilmer Institute. The classification of the stage of the trachoma in these patients is shown in chart 1. On the basis of results of sulfanilamide therapy in other disease conditions, it was decided to give these trachoma patients comparatively large doses, and in every instance the blood level was maintained between 6 and 11 mg. percent. Two of these patients (one with stage-2A trachoma and one with stage-3 trachoma) received sulfanilamide for only four days, when it was stopped in each case because of a febrile reaction. The remaining 11 patients received the drug for an average period of 16 days each. Those two patients who were treated for only four days exhibited definite but transitory improvement, relapsing completely within two or three weeks after stopping the drug. The remaining 11 patients have been followed for an average period of eight months after the sulfanilamide therapy, and 10 of them have remained completely symptom free. The remaining one (stage 2B) has had some mild conjunctival injection which cannot yet be said to be a recurrence of trachoma.

Sulfapyridine has been reported to be effective in a few cases of trachoma,[19] but there is as yet no reason to believe that it is more effective than sulfanilamide.

CHART 1

CASES OF TRACHOMA TREATED WITH SULFANILAMIDE

Stage of the Trachoma	No. of Cases
I	1
II A	2
II B	4
III	4
"Flare-up"	2
Total:	13

Inclusion blennorrhea. The report of Thygeson indicates that inclusion blennorrhea responds to sulfanilamide therapy equally well with trachoma. Thygeson[20] has now treated 14 patients with this disease with sulfanilamide, and has observed prompt clearing in every instance, with disappearance of the inclusion bodies on about the third day of therapy. Two patients in the Wilmer Institute have been similarly treated with equally good results. However, it is doubtful that the use of sulfanilamide is justified in this rather benign disease except as part of a general investigation.

Streptococcus infections. Sulfanilamide remains the drug of choice for B-hemolytic streptococcus infections, although sulfapyridine and sulfathiazole are about equally effective in the same blood concentrations. The nine cases of infection with this organism in or about the eyes which have been treated in the Wilmer Institute with this drug are summarized in chart 2. The result was dra-

CHART 2

B-HEMOLYTIC STREPTOCCCUS INFECTIONS TREATED WITH SULFANILAMIDE

Clinical Diagnosis	No. of Cases	Results
Purulent panophthalmitis	2	Inflammation quickly subsided in both. Some organization of vitreous in one
Infection of lids or orbit	5	Prompt healing in all
Corneal ulcer	2	Prompt healing in both

CHART 3

CHEMOTHERAPY IN STAPHYLOCOCCUS INFECTIONS

Clinical Diagnosis	No. of Cases	Drug Used	Results
Purulent panophthalmitis	3	sulfanilamide	Eyes destroyed in two, slow but complete healing in the other
	2	sulfapyridine	Both healed slowly but completely
	2	sulfathiazole	Complete healing with good final vision in both
Infections of lids or orbit	2	sulfapyridine	Doubtful effect. Slow healing in both
Corneal ulcers	1	sulfanilamide	No definite effect
	1	sulfapyridine	Healed completely within 3 days
	1	sulfathiazole	Healed slowly but cultures remained positive (sulfanilamide ointment used also)
Conjunctivitis	1	sulfanilamide	Questionable slight improvement

matic in every instance.

Staphylococcus infections. With the present agents at hand staphylococcus infections remain among the most unresponsive to chemotherapy. Sulfanilamide has a definite effect upon staphylococci if the drug is present in extremely high concentrations (100 mg. percent or more), far beyond the blood concentration possible to obtain clinically. Sulfapyridine is still more effective, but sulfathiazole and sulfamethylthiazole are the only two drugs which have been used with any real clinical success. These latter two drugs appear to be about equally effective against the staphylococcoccus, but the use of sulfamethylthiazole has been abandoned because peripheral neuritis occasionally accompanies its use. The majority of the infections in the 13 cases summarized in chart 3 were treated before the introduction of the thiazole compounds. Although sulfathiazole exerts a definitely beneficial effect on staphylococcus infections, it still leaves much to be desired; it is certainly not the final answer to this problem.

Koch-Weeks infections. The influenza bacillus (the same organism as the Koch-Weeks bacillus) is inhibited better by sulfapyridine than by sulfanilamide.[21] The effect of sulfathiazole on this bacillus has not as yet been determined. Only three cases of ocular influenza sufficiently severe to warrant systemic chemotherapy have been encountered in the Wilmer Institute. The results in these cases are summarized in chart 4. Cure was rapid in every instance.

Pneumococcus infections. Pneumococcus infections in general are benefited only very slightly by sulfanilamide, but respond somewhat better to either sulfapyridine or sulfathiazole. These latter two drugs have about an equal effect. Only four patients with pneumococcus infections about the eye have been treated with these drugs in the Wilmer Institute, and in only one of these did a definite therapeutic effect follow the use of the drug (chart 5).

Meningococcus infections. Meningococcus infections respond well to sulfanilamide, but probably somewhat better

CHART 4

CHEMOTHERAPY IN KOCH-WEEKS (H. INFLUENZAE) INFECTIONS

Clinical Diagnosis	No. of Cases	Drug Used	Results
Acute dacryocystitis	1	sulfanilamide	Rapid healing
Corneal ulcer	1	sulfapyridine	Rapid cure. Cultures negative within 2 days
Acute purulent conjunctivitis	1	sulfanilamide	Cultures negative within 24 hours

CHART 5

CHEMOTHERAPY IN PNEUMOCOCCUS INFECTIONS

Clinical Diagnosis	No. of Cases	Drug Used	Results of Therapy
Purulent conjunctivitis	1	sulfapyridine	Rapid recovery
Corneal ulcer	2	sulfapyridine	Doubtful, because vigorous local treatment also used

to sulfapyridine. The effect of sulfathiazole is not as yet known. The one case of meningococcus panophthalmitis treated in the Wilmer Institute with sulfanilamide responded dramatically (chart 6).

Results of the treatment of miscellaneous ocular infections are summarized in chart 6. The results are discouraging.

CHART 6

CHEMOTHERAPY IN MISCELLANEOUS INFECTIONS

Bacterial Etiology	Clinical Diagnosis	No. of Cases	Drug Used	Results of Therapy
Meningococcus	Panophthalmitis	1	sulfanilamide	Dramatic cure
B. pyocyaneous	Panophthalmitis	1	sulfanilamide	No effect
B. coli and staphylococcus	Panophthalmitis	1	sulfamethyl-thiazole	May have reduced the infection, but enucleation was necessary
Shiga dysentery bacillus	Corneal ulcer	1	sulfapyridine	Doubtful
H. influenzae and staphylococcus	Panophthalmitis	1	sulfanilamide	No effect
Virus	Herpes zoster ophthalmicus	2	sulfanilamide	No appreciable effect

Other miscellaneous infections. Pyocyaneous infections are not amenable to sulfanilamide even with a high blood concentration. B. coli are inhibited to some extent by all of these drugs, but best by sulfathiazole. Most other gram-negative bacilli (including dysentery bacillus) are likewise best treated with sulfathiazole.

Uveitis. Sulfanilamide compounds have not been used in the treatment of tuberculous or gonococcal uveitis since the publication of the first report. The cases of these types included in chart 7 were reported in detail in that paper. No definite effect from the use of sulfanilamide has been observed in any case of nonsuppurative uveitis, whatever the type. One patient with a peculiar recurrent endophthalmitis for which no cause

CHART 7

CHEMOTHERAPY OF UVEITIS

Clinical Type of Uveitis	No. of Cases	Drug Used	Result
Tuberculous	5	sulfanilamide	No effect
Gonococcal	14	sulfanilamide	No effect
Nonspecific	5	sulfanilamide	No effect
	1	sulfamethylthiazole	Doubtful—cleared rapidly, but had recovered satisfactorily from a previous attack without chemotherapy
	1	sulfathiazole	No effect
Sympathetic ophthalmia	1	sulfanilamide	No effect

could be found was treated with sulfamethylthiazole. The inflammation subsided rapidly, but recovery from a previous attack had been fairly satisfactory without any chemotherapy.

Infections of unknown etiology. Frequently, especially in intraocular infections, it is impossible to determine by culture the cause of an infection in the eye or orbit. In any such instance the best drug to use at present is sulfathiazole. This is probably as effective as either sulfanilamide or sulfapyridine against almost all types of infection, and is certainly more effective against staphylococci and gram-negative bacilli of the colon group. It is more than probable that other sulfanilamide derivatives such as sulfadiazine (which is now being tested) will subsequently be found more efficacious than those now in use. The results of chemotherapy of ocular infections of unknown etiology are summarized in chart 8.

CHART 8

CHEMOTHERAPY OF INFECTIONS OF UNKNOWN ETIOLOGY

Clinical Diagnosis	No. of Cases	Drug Used	Results
Purulent endophthalmitis	3	sulfanilamide	Rapid healing in 2 cases. No effect in 1 case
	2	sulfapyridine	Rapid healing in both, but with organization of vitreous in one
Chronic postoperative endophthalmitis	1	sulfanilamide	No effect
	1	sulfamethylthiazole	No effect
Orbital cellulitis	1	sulfanilamide	Rapid healing
Peculiar deep keratitis	2	sulfanilamide	No effect
Parinaud's conjunctivitis	1	sulfanilamide	Marked improvement

Sulfathiazole is at present being used in the surgical department of this hospital as prophylaxis against infection in cases of injury or operation in which there is an appreciable likelihood of infection, and the results of this type of prophylaxis have so far been very encouraging. The prophylactic administration of sulfathiazole has recently been adopted as a routine procedure in the Wilmer Institute for all patients with intraocular injuries, but the results cannot as yet be properly evaluated.

SUMMARY

1. A simple table of dosage for sulfanilamide, sulfapyridine, and sulfathiazole is given.

2. The toxic reactions of sulfanilamide, sulfapyridine, and sulfathiazole are enumerated.

3. The drugs of choice at present in the treatment of various ocular infections are: (a) For gonococcal conjunctivitis, sulfathiazole is the drug of choice, and should be continued about three days after the first smear. (b) For trachoma, sulfanilamide is the only drug that has been used extensively. A blood concentration of 6 to 11 mg. percent, maintained for two to three weeks, is usually quite effective. (c) For beta-hemolytic streptococcus infections, sulfanilamide remains the drug of choice, although sulfapyridine and sulfathiazole are equally effective. (d) For staphylococcus infections, sulfathiazole is the most effective drug at present available, but even this drug is not very efficacious. (e) For pneumococcus infections, sulfapyridine and sulfathiazole are about equally effective. (f) For Koch-Weeks (H. influenzae) infections, sulfapyridine is more effective than sulfanilamide. (g) For meningococcus

infections, sulfanilamide is quite effective, although sulfapyridine is probably a little better. (h) For infections due to B. coli and most related gram-negative bacilli, sulfathiazole is more effective than either sulfanilamide or sulfapyridine, but at best the therapeutic response is not too good. (i) For infections of unknown etiology, sulfathiazole is at present the drug of choice because it has the widest range of effectiveness. Prophylactic administration of sulfathiazole is recommended in cases of intraocular injury.

Appendix

Dosage:

Average dosage of sulfanilamide required to produce and maintain a blood concentration (of "free" sulfanilamide) between 6 and 11 mg. per cent

Weight		Initial Dose		Total Daily Maintenance Dose		6-hourly Maintenance Dose	
Kg.	lb.	grams	grains	grams	grains	grams	grains
3	7	0.2	3	0.4	6	0.1	1.5
10	22	0.6	10	1.2	20	0.3	5
20	44	1.2	20	2.4	40	0.6	10
30	66	1.5	25	3.0	50	0.75	12.5
40	88	2.0	30	4.0	60	1.0	15
50	110	2.4	40	4.8	80	1.2	20
60	132	2.7	45	5.4	90	1.35	22.5
70 and over	154	3.0	50	6.0	100	1.5	25

This table will not apply in the presence of impaired renal function, because of improper excretion of the drug. Also, it is calculated for a high normal daily urinary excretion (about 1,500 c.c. per day in adults), which necessitates a correspondingly high fluid intake.

An equal amount of sodium bicarbonate should be given by mouth as prophylaxis against acidosis from the sulfanilamide. This is not necessary with sulfapyridine or sulfathiazole.

Sulfapyridine is absorbed and excreted more slowly than sulfanilamide, and there is consequently more individual variation in the blood concentrations resulting from a given dosage, but on a broad average the blood levels will run very slightly lower than in the case of sulfanilamide.

Sulfathiazole is absorbed and excreted rather rapidly. It is therefore necessary to divide the daily maintenance dosage into six parts, one dose every four hours instead of one every six hours, in order to maintain an even blood concentration. The daily dosage given in the table above will maintain an average blood concentration of sulfathiazole between 3 and 9 mg. percent, which is usually quite adequate.

Toxic reactions

1. Symptoms such as nausea, vomiting, weakness, anorexia, vertigo, disorientation, and cyanosis are dependent to a considerable extent upon the blood level maintained. These symptoms are not in themselves an indication of danger from the drug. With the dosage scheme outlined above, almost all patients taking sulfapyridine will be nauseated during at least the first few days of therapy, and over half of those taking sulfanilamide will have some nausea, but comparatively few of those taking sulfathiazole. Disorientation is most frequent with sulfanilamide and least frequent with sulfathiazole. A more or less apparent cyanosis will be present in almost all the patients.

2. (a) Acute hemolytic anemia, often preceded by fever and accompanied by jaundice, constitutes a definite danger. By acute hemolytic anemia is meant a suddenly developing, severe anemia—not the slowly developing, rather mild anemia encountered in a large proportion of patients receiving these drugs. This reaction is not common and rarely endangers life if the drug is promptly stopped and transfusions utilized when necessary.

(b) Rash, almost always preceded and accompanied by fever and leukocytosis, may be dangerous if the drug if not promptly stopped. Very rarely a toxic hepatitis or a polyarthrosis may be associated with this type of reaction. Conjunctivitis or episcleritis is often associated with the rash (or may occur alone) with sulfathiazole, but not with the other two drugs.

Drug idiosyncrasy, as manifested by hemolytic anemia, fever, or rash, usually develops during the first few days of therapy. *These reactions appear almost as often when small doses of the drug are given as when large doses are given.*

3. Leukopenia may develop early or late. The early variety, which usually develops within the first three days of therapy, is usually benign. The late variety, which almost never develops within the first two weeks of therapy, may result in agranulocytosis. This latter reaction is the most dangerous of all the toxic manifestations, and some patients exhibiting it die in spite of promptly stopping the drug. *Its appearance apparently has extremely little relationship to the daily dosage of these drugs.*

4. Acidosis, encountered only with sulfanilamide, will rarely occur if equal amounts of sodium bicarbonate are given.

5. Hematuria and renal calculi, sometimes associated with partial or complete suppression of the urine, is encountered occasionally with sulfapyridine or sulfathiazole. This reaction is due to precipitation of the relatively insoluble drug and of the even-less-soluble acetylated form within the kidney tubules and lower urinary passages.

6. Peripheral neuritis is encountered with extreme rarity with these drugs, but not infrequently in the cases of certain other derivatives such as uliron or sulfamethylthiazole.

Minimum number of tests which will insure maximum safety in giving these drugs

1. Temperature every 12 hours.

2. Hemoglobin on the 1st, 2d, 3d, 5th, and 7th days of therapy and every 4th day thereafter.

3. White count on the 1st, 3d, and 7th days of therapy and every 2d day thereafter.

4. In the cases of sulfapyridine or sulfathiazole, a microscopic examination of the urine every two days.

Indications for stopping these drugs

1. Fever (caused by the drug) of 102°F. or more.

2. Definite rash.

3. Drop in hemoglobin of more than 20 percent within 24 hours. If there is a slow fall in hemoglobin to a very low level, the patient should be given a blood transfusion but the drug need not be stopped.

4. Fall in the white blood count to below 4,000, with relative granulocytopenia.

5. The appearance of an appreciable number of casts and red cells in the urine, or anuria (with sulfapyridine or sulfathiazole).

References

[1] Guyton, J. S. The use of sulfanilamide compounds in ophthalmology. Amer. Jour. Ophth., 1939, v. 22, Aug., pp. 833-850.

[2] ———. The local use of sulfanilamide compounds in the eye. Amer. Jour. Ophth., 1941, v. 24, March, p. 292.

[3] Lockwood, J. S., and Lynch, H. M. Mechanism of action of sulfanilamide. Jour. Amer. Med. Assoc., 1940, v. 114, March 16, pp. 935-940.

[4] Kattiofsky, W. Erfahrungen über die Wirksamkeit der Sulfanilamide bei gonorrhöischen Augenerkrankungen. Klin. M. f. Augenh., 1939, v. 103, Aug., pp. 214-220.

[5] Sysi, R., Ueber die Behandlung der Conjunctivitis gonorrhoica mit dem Präparat M. and B. 693. Acta Ophth., 1939, v. 17, pp. 466-476.

[6] Lian, Sie Boen. Die Anwendung von Uliron in der Therapie der Conjunctivitis gonorrhoica. Ophthalmologica, 1939, v. 97, Aug., pp. 341-346.

[7] McKee, S. H. Gonorrheal ophthalmia cured after one week's treatment with sulfanilamide. Arch. of Ophth., 1939, v. 21, June, pp. 1035-1036.

[8] Barbour, F. A., and Towsley, H. A. Experience with sulfanilamide in treatment of gonorrheal ophthalmia. Arch. of Ophth., 1939, v. 22, Oct., pp. 581-589.

[9] Heinemann. Trachoom. Geneesk. tijdschr. v. Nederl.-Indië, 1937, v. 77, p. 1967.

[10] Lian, Sie Boen. Prontosiltherapie bij Trachoom. Geneesk. tijdschr. v. Nederl.-Indië, 1938, v. 78, May, pp. 1058-1065.

[11] Loe, F. Sulfanilamide treatment of trachoma; preliminary report. Arch. of Ophth., 1938, v. 20, Nov., pp. 880-882; Jour. Amer. Med. Assoc., 1938, v. 111, Oct. 8, pp. 1371-1372.

[12] Gradle, H. Reported in a discussion of Loe's paper (ref. 11).

[13] Kirk, R., McKelvie, A. R., and Hussein, H. A. Sulfanilamide in the treatment of trachoma. Lancet, 1938, v. 235, Oct. 29, p. 994.

[14] Richards, P., Forster, W. G., and Thygeson, P. Treatment of trachoma with sulfanilamide. Arch. of Ophth., 1939, v. 21, Jan., pp. 577-581.

[15] Hirschfelder, M. Sulfanilamide treatment of trachoma. Amer. Jour. Ophth., 1939, v. 22, March, pp. 299-300.

[16] Julianelle, L. A., Lane, J. F., and Whitted, W. P. Effect of sulfanilamide on the course of trachoma. Amer. Jour. Ophth., 1939, v. 22, Nov. pp. 1244-1253.

[17] Spining, W. D. Use of sulfanilamide in trachoma. Amer. Jour. Ophth., 1940, v. 23, March, pp. 271-274.
[18] Thygeson, P. Treatment of trachoma with sulfanilamide. Amer. Jour. Ophth., 1940, v. 23, June, pp. 679-685. Also personal communication to the author.
[19] Spearman, M. P., and Vandevere, W. E. Sulfapyridine in trachoma. Jour. Amer. Med. Assoc., 1939, v. 113, Nov. 11, p. 1807.
[20] Thygeson, P. Personal communication to the author.
[21] Guyton, J. S. The effects of sulfanilamide and sulfapyridine on the Koch-Weeks bacillus (Hemophilus influenzae). Arch. of Ophth., 1940, v. 23, June, pp. 1243-1251.

Discussion

Dr. Genserico Gonzaga Jayme-Goyaz (Brazil): The action of the sulfamides of the three groups reported by the authors is still open to controversy because of the diversity of the results obtained by different observers. Thus it is that for some eye diseases favorable results have been reported for almost all the groups. There is, however, a divergency of opinion as to the relative efficacy, and opinion is also divided in the case of other diseases, in which both positive and negative results have been recorded.

In the palpebral or cutaneous affections of the orbital region, there appears to be a favorable reaction to sulfamide compounds. However, it is imperative to note that the action is hardly curative for the disease, and not preventative of its recurrence. It is important to bear this fact in mind in cases of relapsing hordeolum.

In conjunctival diseases, sulfapyridine is, without doubt, of great efficacy. In gonococcic conjunctivitis, the prognosis is much better since the advent of this medication. One should not, however, base the therapy on chemotherapy alone, for individual tolerance is variable. It is preferable to combine protein therapy and classical local treatment.

Corneal ulcers also respond very favorably to treatment with sulfanilamide, but sulfapyridine gives better results in such cases, since the microörganism responsible is nearly always the pneumococcus. Sulfapyridine has a better effect on this organism than have the other sulfamides.

In partial or total uveitis (iritis, iridocyclitis, choroiditis, properly called uveitis) it appears that the action of sulfanilamide is variable. Even in our cases, in which the etiology certainly follows focal infection, the reaction is not always good, since the organism probably varies and in different cases is differently influenced by the sulfamides.

Although in recent times sulfanilamide as a therapy for trachoma has been praised with such insistency, according to the authors, it does not always appear to be beneficially influenced by this therapy. The use of another chemotherapeutic agent, colloidal cupric carpotrachiate, introduced by subconjunctival injections and combined with intramuscular injections of cupric morrhuato, is preferable.

Tolerance of the sulfamides is variable from individual to individual. In certain cases it is impossible to attain an efficacious dose of 1 gr. per kilo of weight per day. It is advisable not to induce the phenomena of intolerance. This is accentuated more in persons with hepatic insufficiency, and in these cases it is beneficial to administer liver extract and also vitamin B concomitantly, in order to avoid a possible nephritis.

NOTES, CASES, INSTRUMENTS

A ROTATORY CROSS-CYLINDER*

SAM ENGEL, M.D.
San Francisco

Jackson's cross-cylinder is so widely used and its value for refraction so well established that every word in this respect seems to be superfluous.

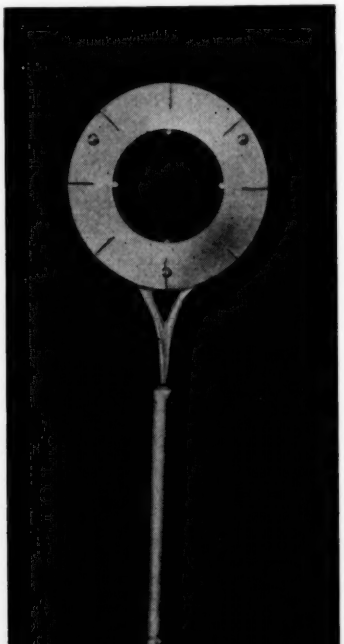

Fig. 1 (Engel). A rotatory cross-cylinder.

After the cross-cylinder is put into the trial frame in a midway-position, the customary procedure of determining the axis of a correcting cylinder lens is accomplished by bringing the axis of the concave cylinder, then the axis of the convex cylinder in an angle of 45 degrees with the axis of the correcting cylinder. The patient is asked to compare the vision in either position. There are two disadvantages to this. First, turning the cross cylinder often places it out of position and this interferes with the intended effect. Second, the trial frame has to be watched rather closely to arrest the cross-cylinder at the right moment. The Woolf "flipping" cross-cylinder and the Pascal "self-setting" cross-cylinder avoid these difficulties by turning the glass forward for 180 degrees. However, the forward rotating of the glass blurs the vision at this moment and abolishes Jackson's very idea, simultaneous comparison.

I have tried to avoid all these disadvantages by the "rotatory cross-cylinder." In this instrument the cross-cylinder lies in a double ring of metal; the inner ring, to which the glass is fixed, rotates within the outer ring, which is put into the trial frame like an ordinary trial lens. Through the handle attached to the outer ring, runs a spring that is connected with a plunger. By pressing the plunger the spring engages a notch and rotates the inner ring 90 degrees. When the plunger is released it returns while the lens remains stationary: pressure of the handle turns the ring again for 90 degrees.

The rotatory cross-cylinder is used in the following way: It is inserted into the trial frame so that the midway-position of the handle corresponds to the axis of the correcting cylinder. Each push of the plunger will rotate the axis of the concave cylinder into the position previously taken by the convex cylinder, a procedure which can be alternately reversed as often as necessary.

* From the Department of Surgery, Division of Ophthalmology, Stanford University School of Medicine.

The rotatory cross-cylinder (0.12 D., 0.25 D., and 0.50 D.) can be obtained from Trainer and Parsons, opticians, San Francisco, California.

Just as the model of the rotatory cross-cylinder was completed, I saw an abstract and later Tree's paper on "A rotating cross-cylinder" (Brit. Jour. Ophth., 1939, v. 23, p. 632). Tree accomplishes the rotation of the cross-cylinder by means of a cogwheel situated at the upper part of the handle, but Tree's instrument has to be held "in front of the trial frame" and still demands a close watching of the turning cross-cylinder.

I should like to thank Mr. A. H. Parsons, San Francisco, for his helpful collaboration.

350 Post Street.

A NEW FOCAL ILLUMINATOR

OTTO BARKAN, M.D.
San Francisco

A lamp is presented that meets the requirements of a small adjustable "hammer" lamp, combined with those of a transilluminator, hand slitlamp, and illuminator of the anterior-chamber angle. It is of light weight and convenient size, and is comparatively inexpensive.

This focal illuminator (fig. 1) is 4½ inches over-all and weighs only five ounces. A ventilating system keeps it cool even after a long period of use. The lens system forms a flat circular patch of light of 500 foot-candles, seven eighths of an inch in diameter at five inches' distance. It may be focused to form a bright slit image of the filament, serving in this instance as an adequate hand slitlamp.

By means of a detachable handle it may be held in the hand or transferred to a flexible goose-neck floor stand provided for it. The light source is a 6 to 8-volt Mazda automobile bulb no. 81, available anywhere for a few cents, the only requirement being the selection of a well-centered filament.

The eight-volt transformer accompanying the lamp is an integral part of the wall plug, the whole assembly being light and easily portable.

The lamp* may also be attached by means of an adjustable bracket to the

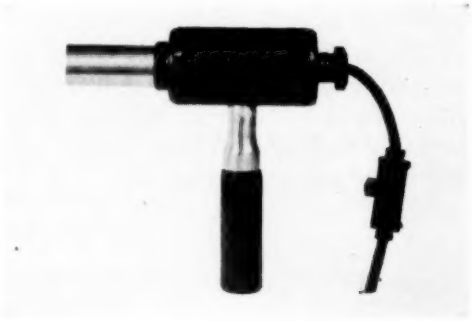

Fig. 1 (O. Barkan). A new focal illuminator.

corneal microscope, operating either from the central position between the two tubes of the microscope or from either side. The change from one side to the other may be readily made. It can likewise be attached to the corneal microscope when used as a micro-gonioscope for examination of the angle of the anterior-chamber.

Transilluminating cones made of plastic material have been devised for it. The cones are both straight and curved and may be cold sterilized.

A cobalt glass filter is also used with it to facilitate the fitting of contact glasses.

490 Post Street.

AN AID IN FITTING CONTACT LENSES

FREDERICK A. WIES, M.D.
New Haven, Connecticut

The fit of a contact lens may be objectively judged by placing a few drops of fluorescein in the lens before inserting

* This lamp may be obtained from Trainer and Parsons, 228 Post Street, San Francisco, California.

the glass. Wherever the lens is in contact with the eyeball, be it sclera or cornea, no green color will be seen. Where there is a space between the eye and the glass, the green color appears. However, it is often difficult to determine whether or not a thin layer of the dye is present. As an aid to this determination Obrig has suggested the use of a cobalt-blue glass filter placed in front of the lens of an ordinary flashlight. This is of some help but is not entirely satisfactory.

By the use of an ultraviolet filter in conjunction with the new Bausch and Lomb "Ortho Lite," a vivid and unequivocal picture of the conditions are presented. When used in the dark room, it is seen that this light causes the dye to fluoresce brightly wherever it has seeped between the lens and the eye. Thus the fit of both ground and molded lenses may be checked with great accuracy.

255 Bradley Street.

SOCIETY PROCEEDINGS

EDITED BY DR. H. ROMMEL HILDRETH

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

January 8, 1940

DR. ARTHUR M. YUDKIN, *presiding*

ANGIOSCOTOMETRY

DR. CHARLES ROSENTHAL spoke on this subject during the instructional hour.

FUNDAMENTAL DIFFERENCES BETWEEN CROSS-CYLINDER AND LINE-CHART ASTIGMATIC TESTS

DR. JOSEPH I. PASCAL stated that line charts as well as the cross cylinder can be used for the three steps in determining astigmatism: (1) to find presence of astigmatism; (2) to locate the exact axis; and (3) to measure the amount. Line chart tests are best made when the eye is half fogged; except in step three, when it is best made with the eye fully fogged. When the eye is in a mixed condition, with one focal line in front and the other behind the retina, line-chart tests are definitely misleading. Cross-cylinder tests are best made when the eye is in a mixed condition; when made with the eye fully fogged, even to a slight extent, the results are indefinite and even misleading.

The cross cylinder is especially valuable for finding the correct axis and for uncovering correctible astigmatism; that is, the kind which is definite and which, when corrected, will enhance the patient's vision or comfort. Cylindrical corrections are often given with the idea of producing a precision focus in the eye. This view is untenable in view of the eye's depth of focus and many other elements which preclude precision focusing in the eye. The concept of a refractive error as a static entity like a trial lens is responsible for this mechanistic view. Cross-cylinder tests have not been extensively employed because of mechanical difficulties involved in applying a loosely held cross cylinder. With a little device now available in which the cross cylinder is set in a mount having its own axis scale and automatic stop the mechanical difficulties have been overcome.

AN EVALUATION OF THE JACKSON CROSS CYLINDER

DR. BENJAMIN FRIEDMAN traced the evolution of the cross cylinder from the Stokes lens. This was an adjustable combination of plus and minus cylinders which was used to provide a spherocylinder of variable power. The form of the Stokes lens which is known to us as Jackson's cross cylinder has a fixed plus and minus lens with axes at right angles to each other, and a handle set half way between the axes of the two cylinders.

In determining the optimum spherocylindrical combination the cross cylinder is, on the whole, less satisfactory than the single cylinders, because the latter offer four possible changes as against two with the former. Also the transitions are less abrupt and hence permit a readier decision as to whether improvement is due to the change in sphere or in cylinder. With the patient's eyes slightly fogged the minus element in the crossed cylinder is valuable at times in assisting him to accept plus cylinder; on the other hand, the plus element in the Jackson cross cylinder is disadvantageous in the accepting of minus cylinder.

For the determination of cylinder strength, use of the cross cylinder involves the recognition of comparative blurs rather than actual increase in visual

acuity. At times this is inconsistent with the final prescription, and as a test that is more subjective in its nature it is less desirable than the more objective criterion of improved visual acuity.

The optical principles involved in the determination of cylinder axis is the increase of cylinder power and the shifting of the tentative axis a few degrees to either side. A simplified test for axis is offered: this consists in temporarily overcorrecting the cylinder power and shifting to either side of the tentative axis. The use of the Jackson cross cylinder is avoided but its optical principle is retained. The test is quick and accurate.

For determining the amount of presbyopic correction required, a cross cylinder is set before the patient's distance correction in the trial frame and the patient fixates upon a cross target held at the reading distance. If the target is in conjugacy with the retina both arms of the cross will appear equally clear. If more or less plus sphere is necessary the horizontal or the vertical arms will appear clearer. This test, from a limited experience, does not appear to be trustworthy. Final appraisal should be reserved until more data are forthcoming from ophthalmologists.

Physiological optics from the viewpoint of practical application to the patient

Dr. Alfred Cowan said that the principal purpose of the eye is to form clear images on the retina. It is far superior to the camera, with which it is often compared, in accommodative range, ability to see under variations of light intensity, and in the clarity of the images seen.

One of the fundamental rules of optics is that the only spot seen distinctly is that which has its image points on the same axis; that is, the eye can get distinct vision only when the visual line passes through the image point, the nodal point, and the fovea. The object and its image thus lie on the same axis. The importance of this to ophthalmologists is that, regardless of where the pupil is situated, the eye can only see when it is in that direction.

During accommodation the dioptric power of the eye is increased and the retinal image is smaller, in spite of the fact that many well-known authors have stated otherwise. The nodal point does advance during accommodation but so does the posterior principal focus shorten, and hence the retinal image is always smaller during accommodation. The correcting lens is placed so that its posterior principal point coincides with the anterior principal focus of the eye; then there is no effect on the retinal image size. In myopia, if the concave lens is placed closer to the eye, the image is enlarged; and, in hypermetropia, the convex lens decreases the size of the image in the same position.

In hypermetropia the convex lens is so placed that its principal focus coincides with the punctum remotum of the eye. This is not so in presbyopia, in which we imagine rays from in front of the eye so that if we should consider it the principal focus of that lens, the rays would enter the presbyopic lens as if they were parallel.

If one eye is hypermetropic and the other is not, there is bound to be a difference in image size in accommodation, since both eyes always accommodate to the same amount. The greatest difference in accommodation by the two healthy eyes is less than one-eighth diopter. If there is more difference, then a disease condition is present.

What occurs? There must be some compensation. Persons with such a condition do not have trouble. Haynes claims that an eye which accommodates two-and-

one-half diopters changes the size of the image 1 percent. What about those eyes that have hypermetropia with a difference of two diopters in the two eyes? They also do not have much difficulty in adjusting themselves. Also there is a size difference in asymmetric convergence and in the person with one myopic and one emmetropic eye. Some persons make the adjustment more easily than others, but all must have a real ability to compensate for size difference.

Two other factors affect the size of the images—the prismatic and spherical portions of the lens. These are also compensated for—unless there is a marked difference in image size—otherwise very few people would ever be comfortable.

Every oculist should know his physiologic optics. But it is just as important to know how and when to apply and not apply the theories when clinical and practical judgment show us that it is unnecessary to be so precise as we are told we need be.

Contact-glass refraction

Dr. Arno E. Town stated that corneal astigmatism need not be considered in contact-glass refraction as the meniscus of saline between the cornea and the glass fills in the corneal defects, producing a regular refraction curve. Lenticular astigmatism must still be considered, and its frequence is surprising.

As the contact glass adheres closely to the eye it possesses various advantages over spectacles. Image-forming defects such as astigmatism of oblique pencils, alternation of perspective, and, in a person with unequal sight in the two eyes, a difference in magnitude of the turning angle of the individual eyes cannot occur. In anisometropia the retinal image is increased in myopia and decreased in hypermetropia, giving a similarity in size of images and permitting binocular fusion.

In correction with contact glasses a magnification of the retinal image is a result of two factors: (a) that of the afocal contact glass, and (b) that of the fluid meniscus in conjunction with axial length. With the practical use of the contact glass aniseikonia can be corrected. In cases of monocular aphakia, binocular fusion becomes possible when the other eye has useful vision. The value of this is apparent, considering the frequency of traumatic cataracts.

The newer method of fitting contact glasses from a mold has superseded the previous trial-and-error method. In making a corneal impression, factors which hinder the production of a perfect negative are improper pressure, a poor plastic, movement of the eye, and the fact that the eye is a soft pliable organ rather than a solid.

Contact-glass refraction is a part of ophthalmology and should be performed by oculists. The refraction is just as important as ordinary refraction, and the taking of an impression requires skill and dexterity and involves manipulations of the eye which are serious and should not be performed by an optician or technician who does not understand the structure and care of the eye.

Sidney A. Fox,
Secretary.

SAINT LOUIS OPHTHALMIC SOCIETY

February 23, 1940

Dr. J. F. Hardesty, *president*

Disciform keratitis with report of a case

Dr. C. W. Tooker presented a paper on this subject.

Discussion. Dr. William Hardy said the subject of keratitis disciformis pre-

sents many difficulties for one who attempts to discuss it. No one sees enough cases in which there is no question as to diagnosis, to formulate a definite clinical picture. The disease is rare and fortunately so. The etiology is clouded in doubt. In fact, there is no exact certainty as to the cause. Many of the cases give, as Dr. Tooker has stated, a history of a preceding trivial injury, such as a foreign body or a simple herpes, but in most cases no such history is present. The theory, and it is but theory, is that the foreign body provides the portal of entry for some type of low-grade chronic infection, the nature of which is not known, or the herpes cornea furnishes a virus which brings about the same result. There is little evidence to substantiate these hypotheses. They are merely assumptions and not facts. The attempt is made to hook up this disease with serpent ulcer, making of it a sublimated and chronic form of that acute and destructive affection. He has been unable, to the present, to stretch his imagination to the point where he could accept this even as a possibility. As to the herpes cornea producing a virus capable of causing disciform keratitis we are again indulging in speculation. The word virus is used rather loosely and may mean many different things to different people. If an ultramicroscopic organism is meant, then it is readily intelligible as a form of microbic infection. If a virus from herpes is considered as the possible etiological factor in disciform keratitis, then dendritic keratitis must be somewhat of an allied condition. It is quite possible or even probable that the ruptured blister of herpes furnishes the point of entry for an infection the nature of which is not known. The disease is rare and the opportunity for microscopic pathological examination is much rarer. Even in those few cases which have come to the laboratory, nothing distinctive nor conclusive has been revealed.

We are told by textbooks to use preventive measures or prophylaxis. How can one know if a given body or herpes of the cornea will eventuate in a disciform keratitis or how does one know that the so-called prophylactic treatment had any effect in preventing it? All ophthalmologists habitually use antiseptic and protective treatment to ward off the ordinary and common infections after injuries to the cornea. It would then seem that disciform keratitis is due to some extraordinary type of infection.

The fact of the matter is that we know very little regarding the etiology of the disease. We know little about its pathology. The condition is treated symptomatically because of our ignorance of its cause and pathology. We are not always certain of the diagnosis and sometimes the disease is incorrectly diagnosed. We are quite certain of one thing in a genuine way, and that is the ultimate result. Despite all that has been used, and nearly everything has been used, the disease drags on over months and ends in a quiet but badly damaged eye, so far as vision is concerned.

Dr. B. Y. Alvis said that recently he had a case of a little girl about 10 years old who had an ulcer resulting in an opaque lesion of the left eye. It began as a typical, dendritic ulcer of the cornea. He treated this for a few days and, since it would not get well, he treated it with iodine. The ulcer healed promptly but immediately afterward the clouding of the central area of the cornea began and progressed to form a disc-shaped opacity. He sent the child to Children's Hospital and her case was studied quite thoroughly. No cause for her condition was found except that she had a latent tuberculosis in a mild form; also a mild sinusitis. She was given X-ray and fever therapy with no influence

on the progress of the disease. This case definitely followed a dendritic ulcer and presented a disc-shaped, central opacity of the stroma corresponding to the description of the disciform lesion.

Dr. William Meinberg stated that he had under his care at present a 37-year-old woman who consulted him because of a painful right eye of three days' duration. She had recently recovered from an upper respiratory infection and had a subsiding fever blister on her lower lip. Examination revealed four small, superficial ulcers in the upper temporal quadrant of the right cornea. He made a diagnosis of herpes corneae simplex and touched the ulcers with tincture of iodine following the method described by Gundersen. Several days later a deep, disc-shaped infiltration appeared in the substantia propria beneath the ulcers. There is no doubt that in this case a disciform infiltration followed the herpes infection.

Dr. L. A. Julianelle said that as he listened to Dr. Tooker's report, it seemed to him that the patient's condition might be either a specific or nonspecific condition. Obviously, it cannot be both at the same time. If the condition is not specific, then a number of different agents may be the cause; but, if specific, there can be only one cause and not the variety expressed in different sources. As for its being a virus disease, there is no reason from the clinical appearance for believing or disbelieving this idea. He did not feel that the evidence cited proves that it may be due to herpes virus. However, it seemed to him that a search for herpes virus during the early stages may have led to a more definite conclusion.

THE POSSIBLE RELATION OF THE INCLUSION BODY OF TRACHOMA TO PATHOGENESIS

DR. LOUIS A. JULIANELLE presented a communication on this subject which was published in this Journal (June, 1940).

Discussion. Dr. B. Y. Alvis said that if the material in inclusion bodies did include individual colonies, does that mean that this scattered material is more dilute? How would one explain that it is less infectious than material grouped in inclusion bodies?

Dr. L. A. Julianelle in reply to Dr. Alvis stated that if the inclusion does represent a colony, then its diffusion in individual particles would naturally cause a dilution of the virus. Since the virus will survive and infect only by penetrating the tissue cells, the inclusion which has differed extracellularly may lose some of its activity. As the infection becomes older, the number of actual inclusions becomes less and the infectivity decreases correspondingly.

OPERATIVE RESULTS IN DETACHMENT OF THE RETINA IN THE WASHINGTON UNIVERSITY SCHOOL OF MEDICINE DURING 1934 TO 1938.

DR. L. T. POST read a paper on this subject.

Discussion. Dr. T. E. Sanders said the high percentage of success in the original cases using the thermophore may be partially explained by the fact that, generally, these were the ideal cases. If there was any doubt, the diathermy was usually used. Those cases in which the thermophore was used in the second and third operations were practically all failures. It has been stated that contact of the retina with the area of choroiditis is essential if reattachment is to be obtained. If, after four or five days, the retina is not attached, a failure will be the usual result. If some means were available to place the retina in contact with the area of choroiditis, which is usually at its height at this time, many of these cases would result in reattachment.

Dr. H. Rommel Hildreth said the improving results obtained these days were encouraging and made one feel more enthusiastic about operating for detached retina. He cited the case of a 30-year-old man who suddenly developed retinal detachment, six months after what seemed like a trivial injury. This was in a small town and X rays were not taken. When examined here a large detachment of the upper half of the retina was present. Intraocular foreign body was suspected and confirmed by X rays, and after two days in bed could be seen half way to the nasal periphery at the level of the disc.

At operation, the medial rectus was freed, as well as the superior rectus. A scleral incision alongside the foreign body admitted the tip of the magnet, but the foreign body could not be dislodged. Under direct ophthalmoscopy, the encapsulated foreign body was grasped by forceps and removed. The upper sclera was then treated with the thermophore and complete reattachment of the retina followed. After one-and-one-half years the retina is still in place, the vision is 20/20, and the field full.

It is interesting that this eye stood so much manipulation but it was certainly doomed had surgery not been performed.

Dr. L. Drews said he had a patient who had 22 diopters of myopia with best vision of 20/250. She developed an extensive detachment in the myopic eye. He advised it was best not to operate. She was 60 years old and the emmetropic eye was normal.

Dr. L. T. Post in reply to Dr. Hardesty said he had not used the thermophore recently in detachments because of a very disastrous result in a child four years old, the eye operated on being the only eye. The thermophore was used at 169 degrees for one minute at several points on the sclera, following which the child had a very serious intraocular hemorrhage. He does not know if it was due to the thermophore or not, although there have been more intraocular hemorrhages resulting from this type of operation than from any other method.

He does not think it is uncommon for detachments beginning above to extend below even when they have reattached above. He believes it is very important to question the patient whether the first symptoms were noted in the lower or in the upper quadrants, because operation should include the upper part of the retina if detachment began there. He started to use the thermophore at a temperature of 169 degrees to coincide with Dr. Langdon's report of four cases treated at that temperature. He believes a lower temperature for a longer period might be better.

Adolph C. Lange,
Editor.

NEW YORK EYE AND EAR INFIRMARY

CLINICAL CONFERENCE OPHTHALMOLOGICAL DEPARTMENT

January 22, 1940

DR. WENDELL L. HUGHES, *chairman*

ULCER OF CORNEA DUE TO BACILLUS OF PETIT

DR. ISADORE GIVNER presented a patient, aged 70 years, who had contracted an infection one week before being seen in the clinic. At the time of examination, there was, in the cornea of the right eye, a superficial annular ulceration 3 mm. from the limbus and about 3 mm. in width. In the center of the cornea was a deep infiltration resembling posterior abscess. Smears from the cornea showed gram-negative diplobacillus on cultures, and on agar showed the same organism; it liquefied gelatin. These last two char-

acteristics differentiated it from the Morax-Axenfeld bacillus. The importance of taking cultures in cases of corneal ulcer is demonstrated, for in this case zinc is specific. The ulcer is responding to 1-percent zinc sulphate, three times daily, and an ointment at night of zinc sulphate 0.5 percent and ichthyol 1.5 percent in vaseline. The rarity of this condition prompted its report. In this country only Scarlett and Gifford have reported like ulcers.

Band-shaped keratitis—a question of therapy

Dr. Robert Johnson reported the case of a man, aged 47 years, who came to the clinic complaining of poor vision of both eyes. He had had red eyes intermittently since 1923. The condition started in the left eye, which became red, photophobic, and painful. It lasted two weeks. In 1924 he had a second attack which lasted three or four weeks, and slightly involved the right eye also. His general health at this time was good. In 1924 he had an attack which lasted two or three months, worse in the left than in the right eye. His vision cleared entirely after this, leaving no opacity. In 1928 he had another attack in both eyes, lasting four to five weeks, in which the left eye was again worse than the right. In 1931 he had a recurrence in both eyes which lasted six months. Photophobia was much worse. Vision cleared entirely after this. In 1932 another attack of both eyes occurred and lasted two months. In 1933 the attack in both eyes was characterized by much pain, and he had to remain in a dark room for two or three months. In 1935 the attack lasted two to three months, but was not so severe as the one in 1933. This too cleared entirely. In 1936 and 1937 he had another attack lasting two to three months with beginning infiltration of the cornea. The patient is sure that the change did not start in the center of the cornea. He states that this opacity cleared entirely and vision remained unaffected. In September, 1937, opacities appeared at the same sites; at this time he had only a slight reaction, and photophobia lasted only a short time and has not returned. The opacity continued to spread and reached its present size in three or four months.

For the past two years he has been able to see very little, better when the pupils are dilated. He was brought into the hospital on November 21, 1939. An optical iridectomy was performed on the right eye. There was a marked reaction, which cleared, and the patient was discharged from the hospital one month after operation. Since leaving the hospital he has been using dionin. The optical iridectomy has not improved his vision.

The patient gave the following history: 1916—infected inguinal lymph glands which became swollen and ruptured; 1920—infected right forefinger; 1924—indirect inguinal repair; 1926—all infected teeth removed; 1928—lues—took treatments for one-and-one-half years at Polyclinic until the test was negative.

Examination showed blood pressure to be 105/70; heart and lungs negative; X rays showed no pathological changes apparent in the bones of the upper or lower extremities. B.M.R. 2 percent below average normal. Serum: calcium 10.0; protein 5.2; albumin-globulin ratio 1:3. On January 12, 1940, the blood was negative except for 13,000 WBC; the blood Wassermann was negative. No bacteria were seen in the eye smears. Urine examination was negative.

Eye examination revealed: Vision O.U. ability to detect hand movements; tension O.U. 20 mm. Hg. There was a large opacity of each cornea of sclerotic, calcium, and chalk deposits surrounded by a narrow band of clear cornea. Diagnosis

of band-shaped keratitis O.U. was made. This case was discussed because a question of treatment was involved.

Discussion. Dr. W. Hughes questioned whether this patient would be a suitable subject for autokeratoplasty.

Dr. B. F. Payne said that when this patient had had an optical iridectomy there was such a terrific reaction that he was of the opinion that other surgery would not be satisfactory.

Case of petit ulcer

Dr. Webb Chamberlain presented the case of a white man, 48 years old, who had had red, painful eyes for five days. He gave a past history of having had lues, treated in 1928; of periodic alcoholism; of poor living conditions. In reference to his present illness he had no complaints referable to his eyes before 10 days prior to admission. He had multiple foreign bodies, and had rubbed his eyes, which became slightly red and irritable for four days, then increasingly painful, with photophobia and tearing. A grossly visible whitish abscess area was evident five days before admission. He received no treatment except boric irrigations.

The right eye showed lid swelling, discharge, circumcorneal, injection, a deep abscess in the lower half of the cornea 6 by 5 mm. in size, and superficial areas of ulceration above. The iris vessels were enlarged, edematous, and there were hemorrhagic exudates in the anterior chamber. Tension was slightly elevated to fingers; vision was the ability to see hand movements.

General physical condition showed diseased teeth, skin scabes, and an old fracture of the nose. The blood count and urine were normal; the Wassermann was negative; X ray of sinuses negative; the teeth showed resorption of bone. Smears and cultures showed large gram-negative diplobacilli growing well on plain agar at room temperature and liquefying gelatin.

The patient was placed under treatment of hot boric acid, atropine, irrigation of the conjunctival sac, and mouth care for pyorrhea. A Saemisch section was performed on admission. Zinc sulphate 0.5-percent drops four times daily, zinc sulphate ointment 1 percent, and sulfanilamide gr. 80 four times daily were given.

Smears and cultures showed pure diplobacillus, which grows well on simple media at room temperature, and liquefies gelatin at room temperature.

Discussion. Dr. A. J. Elliott read a paper on the history of diplobacillus of Petit. The presence of gram-negative diplobacilli in corneal ulceration having those characteristics described by Petit has been reported frequently in European ophthalmological literature. The occurrence of this organism in America is either very infrequent or its bacteriological differentiation has not been made from the diplobacillus of Morax-Axenfeld. Smith, Paul, and Erdmann made studies of diplobacillary keratitis, and Gifford noted that the differentiation between the diplobacillus of Petit and Morax-Axenfeld could only be made by study of cultures. No cases of keratitis produced by the bacillus of Petit were reported. Pusey reported 10 cases of diplobacillary infection of the cornea or conjunctiva, but did not make a distinction between the two forms. Weeks and also Duane and Hastings noted diplobacilli on the conjunctiva or the cornea, but did not identify the bacillus of Petit. Tooke reported that with McNab he had seen one case of corneal ulceration caused by the bacillus of Petit, but he doubted that there was a real distinction between it and the Morax-Axenfeld variety. McKee reported seven cases of corneal ulceration from the diplobacillus of Morax-Axenfeld complicating conjunctival in-

jection. Rosenbauch reported 10 cases of corneal ulceration from which the diplobacillus of Petit was obtained. The ulcers were large and occupied the center of the cornea, and all were accompanied by iritis and hypopyon. Oreste discussed the subject of ulcers caused by the bacillus of Petit. He considered the cornea to be primarily infected and did not see a case in which there was conjunctivitis. In this respect he differentiated ulceration in which the Morax-Axenfeld diplobacillus is found and which is generally seen accompanying or following an attack of subacute conjunctivitis. Moreover, he said the latter was usually situated near the limbus and was rarely complicated by iritis or hypopyon.

McNab reported that he had kept cultures of the Morax-Axenfeld form and the diplobacillus of Petit for four years and by repeated subcultures found that the former always failed to grow on pure agar while the latter always did grow on it. Chaine concluded that the two organisms are distinct biologically and culturally. He maintained that the precipitation, agglutination, and fixation of complement reactions made possible their differentiation. Scarlett described a case of corneal ulceration from which he obtained an organism resembling the Morax-Axenfeld diplobacillus and the diplobacillus of Petit, which grew on blood serum and gelatin, but did not liquefy them. He recorded 6 cases of corneal ulceration caused by the Morax-Axenfeld variety and 13 cases in which the Petit diplobacillus was obtained. He has not encountered the diplobacillus of Petit since that time. Gifford reported a case of central corneal ulceration from which the Morax-Axenfeld variety was obtained. In one case gelatin was liquefied and in the other case there was doubtful liquefaction of the gelatin. Three cases of corneal ulceration produced by the diplobacillus of Petit have been reported by Soudakoff. The organism grows well on the ordinary laboratory media at room temperature, developing fine pin-point colonies in three days. The important characteristics differentiating it from the Morax-Axenfeld diplobacillus are its ability to liquefy gelatin and to grow on plain agar.

Fistula of the cornea with keratoplasty

Dr. Loren Guy reported the case of a white woman, 65 years old, who had come to the clinic with only light projection present in both eyes. The right eye showed complete leucoma of the cornea with fistula. The left eye had a mature cataract. The patient had had an infection of the right eye 35 years previously, and the eye had been poor following that. On November 6th, a keratoplasty was performed in the eye with the leucoma and fistula. The question of whether it should be attempted was present. However, it was done and so far no ill effects have resulted. The tension in this eye, when the patient came in, was about 10 mm. Hg. Fields were taken. The cornea is now clearer than that shown in the slide projected on the screen.

Discussion. Dr. W. Hughes said that we learn a great deal more from the cases that are failures than from those that are successful. It is most important to report cases that are not successful even though they were entered into with the idea that they would probably not be successful. It was generally conceded that this patient would probably not gain from this operation when we first contemplated it. The cornea was available, and we thought it advisable to do the corneal transplantation. It is something from which we can learn about the prognosis in similar cases.

Dr. A. L. Kornzweig asked what the anterior chamber was like, and how it was established that there was a fistula?

Dr. Guy said that the anterior chamber was very shallow and the fistula was established by probing. The operation subsequently proved this.

Corneal dystrophy

Dr. A. L. Kornzweig reported the case of a 72-year-old woman who was first seen in the clinic in May, 1938. At that time she had a mature cataract in the right eye and an immature cataract in the left, mostly posterior polar. Light projection was good in the right eye. There did not seem to be a contraindication to operation. The field was taken and found to be normal, the tension normal, and a smear taken from the conjunctival sac showed a few gram-positive cocci the nature of which was not determined. A combined extracapsular extraction was performed, during which a peripheral iridectomy was made. The operation was uneventful. The postoperative course was stormy, however. The patient developed marked iridocyclitis and there was considerable striate keratitis. The anterior chamber was cloudy. There was considerable reaction around the cornea with ciliary injection. The tension was not elevated. General medical examination at this time did not show any etiological factor to account for this except that the medical examination showed a markedly enlarged heart, blood pressure was 200/90, and there was some evidence of chronic congestion in the lungs. The patient was followed for three months, and on September 1st the upper half of the cornea showed on its epithelial surface several small vesicles. These were limited to the upper half of the cornea. The vesicular condition has been progressive in spite of all treatment that has been instituted. The question arises as to why this patient has a vesicular keratitis, why it is progressive, and what can be done about it. We know of only one similar case of vesicular type following cataract extraction. The tension has been normal—from 18 to 20 mm. Hg. There is no evidence of increased tension. Medical examination is normal. Because of the stormy postoperative course, there was thought to be an anaphylactic process due to retained lens substance. Duke-Elder said that cutting of the nerves of the cornea is not sufficient to cause disturbance after cataract extraction. Large areas of the cornea are anesthetized and no degenerative processes occur. There is another condition which was called by Sanctus superficial neurogenic keratitis. Ten percent of all persons have normally a diminution of corneal sensitivity, and are liable to attacks of herpes fibrilis.

Dr. Kornzweig said that he presented this problem because he thought it to be of interest that a patient with cataract extraction developed this type of keratitis. He believed that the patient has a depressed corneal sensitivity because she is hypesthetic in both eyes. The cataract extraction caused further depression of her corneal sensitivity. He thought this to be a neurotrophic type of keratitis similar to that described by Duke-Elder.

Discussion. Dr. D. W. Bogart said that he had a case that reacted somewhat in the same manner. In general the patient did well under atropine and hot compresses, and sulfanilamide. The patient had had an infected conjunctival sac prior to operation; this had cleared up. The sac was removed, but there were no organisms.

Pemphigus

Dr. Byron Smith reported the case of a patient who first came to the clinic in 1936, complaining of a sore right eye of 10 years' duration. Previous trouble with both eyes had been present, and he had an entropion with trichiasis O.U.

He was treated by a Kuhnt-Szymanowski operation for entropion. Following that he had a number of operations on the conjunctiva. The conjunctiva is very loose and has a tendency to roll over the cornea. Sulfanilamide was administered without any change occurring in the condition. At the present time the patient is using petrolatum, which is instilled in the eye. Bacteriological study has thrown little light on his condition. Mixed infection is present. In the smear some rounded bodies that look like a form of yeast are present.

Discussion. Dr. W. Hughes said that this is a type of case that we fortunately do not come across very often. This type of condition with loose conjunctiva is not uncommon especially in older people. The lower lid pushes up a fold of conjunctiva over the limbus, and it is most annoying. It might be of benefit to dissect up the conjunctiva and let it grow back into place, the resulting scar tissue making it adhere more closely to the sclera.

Dr. I. Givner said that he had been particularly interested in pemphigus, and has been observing six cases. He did not believe that the case presented by Dr. Smith is pemphigus. The pathology of pemphigus is subconjunctival fibrosis, whereas, in the case presented, there is conjunctival laxity. We find that streptococci are found in 3 percent of normal conjunctiva. Dr. Givner thought that the media were such that streptococci like to grow in them. In cases of this sort sulfanilamide will clear away the streptococci for about three months, but then the organisms will reappear. For pemphigus of the skin vitamin D is now being given. Dr. Givner said that he has tried vitamin D, 50,000 units a day, in ocular pemphigus. The mouth lesions are definitely improved, but little change occurs in the eye findings. However, on local instillation of vitamin D, in one case, marked improvement occurred. He did not advise the general use of this procedure, however, until it has been determined whether or not deleterious effects might result from the instillation on other parts of the eye.

Dr. A. A. Knapp said that in the very few cases of pemphigus that he saw there is a contraction of the conjunctiva and obliteration of the fornices. There are no folds of conjunctiva. This is more of a xerosis. He said he had a patient with xerosis who was given cod-liver oil locally, and the condition disappeared. There is no basis for the use of vitamin D in this case, but there is a definite basis for vitamin A.

Dr. McDannald said that he suggested sending the specimen of blood to Washington because it is the only place to get the complement fixation for pemphigus.

Keratoglobus

Dr. Byron Smith reported on a case of kerotoglobus in which the diagnosis is evident. The question of treatment arises, however. The patient has prominent corneae bilaterally. The patient, a man of 39 years, came into the clinic regarding the advisability of keratoplasty. The history dates back to 1919 when he began to lose vision. There seemed to be a gradual diminution of acuity. In 1924 the patient had pain and rapid loss of vision which later returned. Acuity has since gone down. Drops have been used for a long time. At the present time he has light perception O.U., and projection in all fields is good. The tension is elevated. Transillumination is negative in both eyes. The depth of both anterior chambers is very great. The cornea of the right eye is cloudy and the fundus could not be seen. The left eye has a fundus reflex, but no detail was seen. Dr. McDannald had suggested that a posterior sclerotomy be made to reduce the tension and avoid

intraocular hemorrhage following filtering procedure; after which a filtering procedure could be performed. If the tension were controlled, it would be possible to consider keratoplasty at a later date.

Discussion. Dr. McDannald said he regarded this a hopeless case. Tension is very high. It was felt that any tension obtained with a tonometer would be worth nothing since his tension appears to be about 95-100 in both eyes. He added that he suggested performing a posterior sclerotomy as a last resort. Afterward a decompression operation could be considered. As for a keratoplasty, that would depend on the outcome of the other procedures.

Paul T. McAlpine,
Secretary.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

February 20, 1940

DR. J. HERBERT WAITE, *presiding*

REMARKS ON RECENT OBJECTIONS TO THE HELMHOLTZ THEORY OF ACCOMMODATION

PROFESSOR NORDENSON (of Stockholm, Sweden) read an interesting paper on this subject. He said that the first complete theory of accommodation was given by von Helmholtz in 1853. Objections were advanced by Tscherning, but these were refused by von Hess and Gullstrand.

More recently objections have again been raised against this theory. The most serious of them have emanated from von Pflugk. This author investigated the elasticity of the zonula fibers and showed that these fibers, which formerly had been assumed to be entirely rigid, were, on the contrary, very elastic—eight to nine times as elastic as the capsule of the lens. From this fact he denied that, considering the small space in the eye, their stretching could have any influence on the surface of the lens.

As these findings of von Pflugk seemed to be a most serious objection to the prevailing ideas about accommodation, the problem was taken up by Dr. Odgvist. He repeated the measurements of von Pflugk and likewise found that the zonula fibers were more elastic than the capsule of the lens, although the difference seemed to be less than in von Pflugk's experiments. It still remained to be explained how these more elastic fibers could exert an influence on the capsule. An analysis of the mathematical theory of the mechanism of accommodation, however, revealed the importance in this respect of the fact that the surfaces of the lens are not plane and that the zonular fibers do not lie in the same plane as these, as was supposed by von Pflugk. Owing to the angles that the tangents of the surface of the lens make with one another, and with the fibers of the zonula, a far lesser tension of the latter is required to induce a deformation of the surfaces of the lens. It was shown also that this effect was amplified by the fact that the zonula is anisotropic; that is, it has a different elasticity in different directions.

The effect of the zonula upon the lens is clearly shown when the zonular fibers are cut off in the enucleated eye—the lens then assumes a more spherical form. That the curvature of the surfaces of a bladder suspended in a girdle of springs of considerably greater elasticity is influenced by even a very slight tension of the springs was shown in a model which Dr. Nordenson demonstrated.

Virgil G. Casten,
Recorder.

AMERICAN JOURNAL OF OPHTHALMOLOGY

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SULFANILAMIDE LOCALLY FOR GONORRHEAL OPHTHALMIA

A number of writers have reported brilliant results from the oral administration of sulfanilamide and its derivatives in gonorrheal ophthalmia. With general agreement as to the therapeutic activity of these drugs we find some uncertainty regarding correct dosage, and also an important degree of apprehension as to the risks involved.

It has been stated that the newborn infant usually displays a very satisfactory tolerance to the sulfanilamide group of preparations. But here and there the boundary between safe and lethal dosage has been approached too closely for the comfort of the physician and others, and some fatalities have been recorded. It is disturbing to feel that the most dramatic cures have been effected in cases in which the patients approached complete asphyxiation. On the other hand, cases have been reported (for example by Slobozianu and Herscovici) in which there seemed to be a resistance to the drug, and the gonococcus did not disappear until after an interval of from two to three weeks.

With the pardonable desire to arrive at clinical results rather than scientific conclusions, most workers have combined the use of the sulfanilamides with one or more of the older methods of treatment.

Very few physicians appear to have resorted to local administration of the

drug. Rein and Tibbetts (American Journal of Ophthalmology, 1939, volume 22, page 1126) reported fifteen cases in which the only treatment used was irrigation of the eye, every fifteen minutes, with a preparation of 0.5-percent sulfanilamide in physiologic salt solution. Only where other gonorrheal involvements were present was the drug also administered by mouth. The results obtained by these authors were eminently satisfactory, a remarkable improvement occurring within twenty-four hours.

Bruens (Klinische Monatsblätter für Augenheilkunde, 1940, volume 105, page 430), who claims to have been the first to propose local administration of the drug, reviews some interesting historical details as to ophthalmia neonatorum. As early as 1545, Thomas Raynalde is said to have advised repeated irrigation of the conjunctival sacs immediately after birth. Credé's original proposal for prophylactic treatment with silver nitrate called for the placing of a drop of the solution directly on the cornea. In spite of the introduction of this means of prophylaxis in 1881, Cohn reported in 1901 that in the institutions for the blind thirty-one percent of the children under ten years of age had been blinded by ophthalmia neonatorum.

It may not be altogether improper to say a word about Bruens's claim of priority in the local use of a sulfanilamide derivative for the treatment of gonococcic conjunctivitis. Rein and Tibbetts apparently began their experiments on dogs' eyes in the early part of 1938, and started the use of the drug in human subjects soon afterward. (Their paper was submitted to the editor of the American Journal of Ophthalmology in March, 1939.) Bruens seems to have made his first actual use of local treatment with a sulfanilamide preparation in the early part of December, 1939. He thus, although worthy of credit for his independent initiative in this matter, is mistaken as to actual priority, since the paper by Rein and Tibbetts was written nine months before Bruens made his first application of the method, and the American essay was actually in print before Bruens began his procedure.

To investigate the possibility of destructive action by the drug upon the superficial structures of the eyeball, Rein and Tibbetts resorted to animal experimentation, irrigating the eyes of dogs with a saturated solution (0.8 percent) of sulfanilamide. Bruens, apparently limited as to facilities for tests upon the lower animals, caused his own tarsal conjunctiva to be painted with a thirty-percent solution of "albucid" (the proprietary name of a drug whose chemical title is "aminbenzolsulfonacetamid"). Almost no irritation was produced in either of these experiments.

Bruens's first trial on a human subject was made in an infant whose eyes had responded rapidly to internal use of albucid. Three subsequent cases were given merely local treatment with albucid, in combination with irrigations of physiologic salt solution. Although a thirty-percent solution of the albucid was at first used, subsequent trials seemed to indicate that a ten-percent solution was adequate.

Readers of the American Journal of Ophthalmology will remember that Rein and Tibbets irrigate the "infected eye or eyes for fifteen minutes, night and day, with a 0.5-percent solution of sulfanilamide made up in normal saline solution," the precise amount of solution used in the irrigations varying according to what is required to keep the eyes clean. Their patients are discharged when three consecutive daily smears show absence of

intracellular or extracellular diplococci. No relapses occurred after the use of the treatment in fifteen cases, and the interval before a negative smear was obtained averaged rather less than seven days, as compared with an average of twenty-seven days under earlier methods.

Bruens lays emphasis (perhaps excessively) upon a special technique for instillation of the albucid solution. The everted lids are held in contact, the solution dropped on the exposed conjunctivas, and the two conjunctival surfaces then massaged one against the other. The treatment is repeated every half hour, and, as stated above, is supplemented by irrigations with physiologic salt solution. In his three cases Bruens reports that negative smears were obtained respectively twenty-one, twenty-one, and nine hours after starting the treatment with albucid, in strength varying from thirty to ten percent.

W. H. Crisp.

EXOPHTHALMIC OPHTHALMOPLEGIA

Under this heading an interesting and instructive case was reported in The Lancet for January 11, 1941, by Doctors Martin and Pennell, of Cambridge, England. A man aged 52 years, came complaining of double vision and loss of weight, with swelling of the eyelids. Correction of his refraction cured the swelling of the lids; but six months later his friends noticed his eyes to be "staring." He was still losing weight. Shortly after this he noticed double vision on looking up. He had palpitation of the heart and felt weak if he walked up hill. There was retraction of the lids, with exposure of the sclera above the cornea, and paresis of both external recti, with diplopia when looking to either right or left. The exophthalmos was relatively slight.

Exophthalmic goitre is described in every recent textbook on ophthalmology: with Graefe's sign, failure of the upper lid to follow the eyeball on looking down; Dalrymple's sign, retraction of the upper lid; Stellwag's sign, infrequent and incomplete winking; and Moebius's sign, deficiency of convergence. In most descriptions of the disease, the emphasis is placed upon the disturbance of nutrition in the orbit as pushing the eyeball out of place. But it has generally been recognized that there was also deficiency of the eye movements and weakened muscles.

Within the last three years at least five papers have been published emphasizing the element of ophthalmoplegia. In this same number of The Lancet, Walshe of London has published a paper on "The etiology of polyneuritis," which he thinks cannot be explained by deficiency of the so-called "neuritic" vitamin B_1. Many of the reported cases of exophthalmic goiter have indicated deficiencies of eye movements, suggestive of bilateral polyneuritis. Walshe does not give any general theory of the etiology of the disease. But the recognized features of exophthalmic goiter, its onset, and its course closely resemble those of polyneuritis in other parts of the body. From the standpoint of evolution, binocular vision is a recent acquirement, peculiar to man and the nearly related anthropoids. On this account binocular vision must be recognized as especially unstable and liable to defects.

It becomes important in every case of exophthalmic goiter to test carefully the binocular movements, to note in what respects they are defective, and, following the course of such a case, to record the evidences of motor defects at various

times from the onset to the period of report. In this way we may gain a better understanding of what has been a striking and important deviation from visual health. We cannot hold that these cases are due simply to failure of the thyroid or of the pituitary to control nutrition. We should become familiar with the usual course and results of polyneuritis in other parts of the body. These conditions, which have heretofore not been closely associated in our thinking, may each throw new light upon the essential character of the other.

Edward Jackson.

OFFICE PRACTICE, 1941

A few years ago there died in a midwest city an ophthalmologist of the "old school." After several years of training under the nineteenth-century continental masters he returned to his home town and became associated with a leading practitioner. In a short time he inherited an enormous practice. He built a clinic and private hospital modeled after the European eye clinics and personally attended more than a 100 private patients daily. He practiced for over 50 years. Such was his love for his work that he continued to the end, although he saw the number of his patients rapidly dwindle to but a few a day in the later years.

It was interesting to see the case books he kept over this period. The only information he recorded was the patient's name, age, address, reference, diagnosis, treatment or what was ordered, and the financial aspect. There was an occasional and rare rough sketch of the lesion found. Altogether not more than two or three lines were devoted to each patient. Yet his work was of the finest quality according to those times.

In contrast, consider office practice at the present time. The modern ophthalmologist is expected to make a note of the history, general physical and social background, inspection, skiascopic findings, refraction, slitlamp and corneal microscopic studies, multiple tests for muscle imbalance and fusion power, tonometry, perimetry, external ocular and fundus photography, operative notes and descriptions, the advice and treatment given, and like data. These files are necessary and important, and the measure of a physician's success depends to a large extent upon the accuracy of his records.

The busier he becomes the more need for precise records, and he soon is compelled to have a secretary whose sole duty it is to take down his dictation during the examination. Woe betide him in court if his records are not adequate according to modern standards. If he has a conscience, that inner voice which forbids him to take short cuts during the study of his patient, his notes will be complete, but the patients seen per day will be few in number.

In addition there is an increasing volume of reports to fill out and send to insurance companies, industrial commissions, railroads, lodges, lawyers, and referring physicians. Certificates are to be mailed to schools, draft boards, blind commissions, welfare and other agencies. A short note will not do, the information must be exhaustively given.

If he is to get any intellectual benefit out of his records, he must have a working cross index. This is frequently most difficult and often inefficient, yet without it he will not grow, for the periodic review of his cases is necessary for the welfare of his soul.

It seems about time that these matters should be streamlined and modernized. All case records and reports could be noted on a single standardized form for all purposes. It should be as simple as

possible, and suitable perhaps for carbon copying or photostating.

Workable cross indices ought to be available. Surely a system could be devised that would require but a few minutes at the end of the day to bring it to date. Yet there is little or no information on this point available to the young man starting in practice.

It would be of great value to all of us, therefore, if one of the ophthalmologic societies were to devote a part of its program to a discussion of these problems. An interchange of ideas and notions would undoubtedly bring forth plans for the relief of our office burdens.

Derrick Vail.

BOOK NOTICE

TRANSACTIONS OF THE PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY. Twenty-Eighth Annual Meeting, 1940, vol. 25. Cloth bound, 287 pages.

This volume follows the format of previous issues. The Society evidently had one of its usual interesting meetings, this time at Spokane, Washington, on June 24th to 27th. Dr. Frederick W. Sproul presided.

The instruction program is excellent, vying with that of the Academy. Many interesting papers were included in the scientific program. The first one, "Fifty years' study and experience in ocular motility," by Walter B. Lancaster is a classic. The reading of it would be profitable to anyone. It is so good that it will appear later in this Journal. Hence, a detailed description is not given here.

The second paper is a report by John P. Lordan on "Orthoptic training." The author is apparently enthusiastic about this training.

Max Fine discusses the present status of the corneal transplant operation, presenting a few cases of his own. He has devised a punch that he uses. He summarizes the subject briefly as regards types of operation and factors important for good results.

Warren D. Horner gives some practical points in handling non-industrial eye injuries.

A case of the rare disease, Dysostosis multiplex, with ocular findings is given by Dr. C. A. Veasey, Jr.

Dr. Frank B. Kistner decompressed three orbits for exophthalmos cases, using Naffziger's operation in one case and Sewall's method in the others. He preferred the latter.

Dr. Meyer Wiener talked on the after care of cataract and glaucoma operations. This was a very practical paper.

Dr. Rodman Irvine and Mrs. Irvine presented a paper on "A study of the aqueous humor as an aid to understanding inflammatory conditions of the eye." This work was rather inconclusive, but gives hope for the future.

Dr. Edwin M. Neher illustrates a new method for transplanting pterygium. The reader will not find much difference from those previously described. The original feature claimed by the author consisted in the upward transplanting of the pterygium.

The next meeting of the Society will be held in Los Angeles in 1941. Dr. Isaac Jones of Los Angeles will be the next president.

Lawrence T. Post.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP
ASSISTED BY DR. GEORGE A. FILMER

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

1
GENERAL METHODS OF DIAGNOSIS

Bycigin, A. **A simple method of ophthalmoscopy.** Viestnik Opht., 1940, v. 16, pt. 6, p. 490.

The author describes a fixed arrangement for indirect ophthalmoscopy. (Illustrations.)

Callahan, Alston. **Annular scotoma.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 196-199.

Ferree, C. E., and Rand, G. **Pilot fitness, a safety factor in aviation.** Brit. Jour. Ophth., 1940, v. 24, Dec., pp. 581-597.

Much attention is given to the mechanical perfection of a plane before it engages in flight, while comparatively little is paid to the complete fitness of the pilot. An instrument has been designed and put in use which is compact, easily operated, and portable. The instrument tests both the motor and sensory functions of the eyes in the same proportions as occur in the act of seeing different objects in different directions and at different distances. Estimating the dynamic speed of vision and the time measurement required to change from near to far and from far to near is a part of the test. (Figures, references.) D. F. Harbridge.

Seidenari Renato. **Application of electroencephalography in occipito-ocular derivation in the study of some ocular affections.** Riv. Oto-Neuro-Oft., 1940, v. 17, Jan.-Feb., pp. 1-17.

Two electric waves are formed, one originating in the brain cortex and the other in the retina. The changes in these waves provoke changes in the electric tracings. The differences between the tracings of normal eyes and the tracings of eyes affected by glaucoma and retinal detachment are shown in 29 diagrams. (Bibliography.)
M. Lombardo.

Verhoeff, F. H. **Improved method of staining, within tissues, leptotriches of Parinaud's conjunctivitis and Gram-positive micro-organisms.** Jour. Amer.

Med. Assoc., 1940, v. 115, Nov. 2, p. 1546.

A modified Gram-stain technique is described by which leptotriches are easily recognized and sporotriches can be stained.

George H. Stine.

2

THERAPEUTICS AND OPERATIONS

Berezinskaja, D. I. **The effect of diathermy on the anterior ocular segment.** Viestnik Opht., 1940, v. 16, pt. 6, p. 466.

The tabulated data of this laboratory investigation on guinea pigs show that diathermy increases corneal permeability, augments and prolongs the action of miotics, and raises somewhat corneal sensitivity; it also augments the action of mydriatics, but reduces their action time. In spite of the augmenting effect of diathermy on miotics, its application in glaucoma is inadvisable because in some cases diathermy per se produces a rise in intraocular tension. Ray K. Daily.

Charamis, J. S. **Postoperative delirium.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Oct.-Dec., p. 300.

Removal of the double-eye bandage is advised to allay this condition.

George A. Filmer.

Gundersen, Trygve. **Convalescent blood for treatment of herpes zoster ophthalmicus.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 124. (See Amer. Jour. Ophth., 1940, v. 23, Dec., p. 1412.)

Meyer, K., Bloch, H. S., and Chamberlain, W. P., Jr. **The distribution of sulfapyridine between blood, aqueous humor, and cornea.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 60-62.

Németh, Lajos. **Histamine sensitivity of eye patients.** Orvosi Hetilap, 1940, v. 84, no. 42, p. 540.

If the clinical signs or the history given by a patient arouse suspicion that an eye disease is of allergic origin, the author injects histamine intracutaneously for diagnosis and, if the reaction is positive, for therapy. The reaction is considered positive if after three minutes a wheal appears surrounded by a red area of skin. The initial dose for therapy is the weakest solution that gives a positive skin reaction, the doses being gradually increased.

R. Grunfeld.

Petrov, D. G. **Evipal-sodium anesthesia in ophthalmology.** Viestnik Opht., 1940, v. 16, pt. 6, p. 493.

Brief reports of 12 cases. The merits of this anesthesia are its harmlessness and ease of administration.

Ray K. Daily.

Petrov, M. D. **A description of the isothermic box of the ophthalmic hospital in Talsk.** Viestnik Opht., 1940, v. 16, pt. 6, p. 504.

A description of an ice-box arrangement for the preservation of cadaver tissue. (Illustration.) Ray K. Daily.

Rittenhouse E. A. **Myopia after use of sulphanilamide.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1139-1143. (See Section 3, Physiologic optics, refraction, and color vision.)

Savin, L. H., and Tyrrell, T. M. **A preliminary note on the use of retrobulbar proctocaine anesthesia for the relief of intractable ocular pain.** Brit. Jour. Ophth., 1940, v. 24, Nov., pp. 560-564.

The authors feel that proctocaine retrobulbar injections may safely be

recommended for painful eyes with full corneal sensitivity and poor vision. Of 18 painful eyes so treated, 11 experienced complete relief from pain, five partial relief, and two no relief. Failure in one case was attributed to faulty injection; it was deemed unwise to attempt a second injection. There were two cases of diplopia following proctocaine injection, but both cleared rapidly. In two cases some of the oil came forward subconjunctivally, in one case disappearing within a few days, in the other remaining three weeks. Comparatively small doses have been used, there still being doubt as to whether the almond oil is absorbed from the orbit. Further research is indicated. (Case presentations, references.)

D. F. Harbridge.

Varshavskaja, P. P. **Lysozyme in ocular diseases.** Viestnik Opht., 1940, v. 16, pt. 6, p. 471.

On the basis of 65 clinical cases, the author gives the following indications for the use of lysozyme: conjunctivitis, corneal ulcers, injuries, and trachoma with pannus. The action of lysozyme is superficial; for a deeper effect the superficial corneal layers should be curetted away. Ray K. Daily.

3

PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Boehm, von Gundo. **A new entoptic phenomenon in polarized light.** Acta Ophth., 1940, v. 18, pt. 2, p. 143.

The author describes an entoptic fan-shaped phenomenon produced by straight or elliptic polarized light. The apparatus required consists of a dark background with a small central source from which emanates a constantly rotating, intense, horizontally polarized light. The apparatus permits of variations in the light intensity, the size of the light surface, and the rotation frequency. The entoptic image disappears if the polarizor stands still, and if the image of the light is directed on the fovea. Unlike Haidinger's brushes, this image is seen at the periphery; it has no relation to the macular structure or color, and can be produced in any light, in persons of any age, and in aphakic and color-blind eyes. The phenomenon is attributed to a difference in small particles of light. The author produced similar images on a model made of a mastix-filled emulsion.

Ray K. Daily.

Boehm, Von Gundo, **Haidinger's macular polarization brushes, and a polarization ocular defect.** Acta Ophth., 1940, v. 18, pt. 2, p. 109.

The author has devised a set-up which permits variations in light intensity, rotation frequency, and direction of polarized light. With this device he finds it possible to elicit the Haidinger polarization brushes in every test subject in normal form and size, provided the fovea is normal in color and function. By the interposition of various filters the color of the brushes may be varied; yellow brushes are seen more readily on a dark-blue than on a light-blue background. The color and distinctness of Haidinger's brushes are determined principally by the individual variations in the foveal coloring. If the yellow color of the macula is lacking this phenomenon cannot be elicited, as is also the case in color blindness. The phenomenon is attributed to a double absorption of the yellow pigment in the macula. In some persons this image appears gray instead of yellow. The author believes that such persons have a color anomaly consisting in color fatigue. The author describes a polari-

zation defect of the eye analogous to physiologic astigmatism, the effect being that of interposition of a double refractive medium in front of the light-perception elements. What substance reacts in this manner has not as yet been determined; it can be demonstrated only through the polarization brushes. The apparatus required is a constantly rotating polarization light and a Soleil-Babinet compensator.

Ray K. Daily.

Engel, Sam. **Colored charts as a supplementary test for macular vision.** Arch. of Ophth., 1940, v. 24, Nov., pp. 910-915.

Five cases are briefly reported to show that more exact information about macular vision could be obtained when the usual test with a black and white chart was supplemented by a test with colored figures on a gray background. The test, which can be performed in a few minutes, is particularly indicated when the visual acuity is approximately normal but the patient's statement suggests a slight impairment of the macular function. The chart may also be used with red-green glasses to prove monocular simulation.

J. Hewitt Judd.

Luedde, W. H. **What subluxated lenses reveal about the mechanism of accommodation.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 40-45.

Ogle, K. N., Imus, H. A., Madigan, L. F., Bannon, R. E., and Wilson E. C. **Repeatability of ophthalmoeikonometer measurements.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1179-1189.

The analysis of the repeatability tests indicates definitely that the use of the ophthalmoeikonometer with the polarized eikonic targets is reliable for measuring differences in the sizes of the ocular images at distant vision. The tests in the horizontal meridian at near vision are less reliable, and considerable judgment is necessary to evaluate the findings obtained. A random selection of subjects on whom remeasurements of differences in the sizes of the ocular images were made after the lapse of a period of several years showed a good repeatability and thus gave evidence for the stability of such differences. The refractive technique employed on the ophthalmoeikonometer, in which binocular vision is maintained, is a reliable and accurate method of measuring and balancing the refraction of the two eyes. This study has also suggested certain improvements and the direction for development of the present instrumentation and technique, and has focused attention on the need of repeatability data in other ophthalmic measurements.

J. Hewitt Judd.

Rittenhouse, E. A. **Myopia after use of sulphanilamide.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1139-1143.

A case of transitory myopia following the use of sulphanilamide is described. Several similar cases are reported in the literature. The prognosis is good, since all cleared up following discontinuation of the drug. Various possible mechanisms of the reaction are discussed. J. Hewitt Judd.

Smart, F. P. **Some observations on crossed cylinders.** Arch. of Ophth., 1940, v. 24, Nov., pp. 999-1000.

The author calls attention to the specific advantage of the cross cylinder for determining amount of astigmatic error, based upon the modification in sphere which accompanies each change in cylinder.

J. Hewitt Judd.

4

OCULAR MOVEMENTS

Badtke, Gunther. **A case of mirror-like convergent strabismus in uniovular twins.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 231.

Twin sisters 17 years old presented this condition. C. Zimmermann.

Beliakov, A. A. **Determination of the angle of strabismus.** Viestnik Opht., 1940, v. 16, pt. 6, p. 510.

A description of the use of a tangent scale at a 35-mm. distance.

Ray K. Daily.

Coppola, Luigi. **Paralysis of the left external rectus muscle following spinal anesthesia in a climacteric subject.** Riv. Oto-Neuro-Oft., 1939, v. 16, Nov.-Dec., pp. 448-458.

A 46-year-old woman developed severe headaches and paralysis of the left external rectus muscle 28 days after a hysterectomy. The operation had been performed under spinal anesthesia using a 5-percent solution of novocaine. Lumbar puncture revealed increased intracranial pressure, and the symptoms disappeared following endocrine treatment. (Bibliography.)

M. Lombardo.

Gifford, S. R. **Tendon transplantation for paralysis of the external rectus muscle.** A further report. Arch. of Ophth., 1940, v. 24, Nov., pp. 916-923.

The author's technique of tendon transplantation with recession of the internal rectus muscle is described, and the results of operation in 11 cases are summarized and tabulated. The author concludes that transplantation of living tendon slips from the superior and inferior recti muscles offers the best chance for cosmetic and functional results, which on the whole were satisfactory. All the patients except two had a useful field of binocular fixation while holding the head straight and did not hold the head in an abnormal position. No vertical imbalances or deviations occurred as a result of the operation. In cases with primary deviation of over 15 degrees a recession of 5 mm. is usually safe. Overeffects are rare and can usually be overcome by replacing the internal rectus muscle. Tenotomy of the internal rectus should be reserved for cases in which there is marked contracture of that muscle. In cases of acquired paralysis if no improvement has occurred after three to six months of observation, and especially if the paralysis is increasing, operation is indicated. In cases of congenital paralysis it may be safely performed at the age of three to five years. The operation should be performed before secondary contracture has occurred. J. Hewitt Judd.

Harms, Herlyn, and Renner. **Critique of treatment of squint.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 129.

This essay is based on a review of 174 cases operated upon in the eye clinic of Berlin and later careful examination of fifty of these cases. The correct treatment of squint requires full understanding of the physiology of binocular visual function, and careful examination and observation of the patient. C. Zimmermann.

Lijo Pavia, J., and Cerboni, F. C. **Vertical strabismus.** Rev. Neuro-Oto-Oft., 1940, v. 14, Feb., p. 47.

The authors report a case of concomitant vertical strabismus in a seven-year-old boy who had sustained a head injury at two years of age. The vision was normal in each eye. (Photographs.)

Edward P. Burch.

Lyman, R. S. **Eye movements in the electroencephalogram.** Bull. Johns Hopkins Hosp., 1941, v. 68, Jan., p. 1.

In this series of experiments, in addition to the usual method of taking electro-encephalograms, electrodes were placed all around the eyes to record brain waves caused by eye movements. The results were not very positive and cannot yet be clearly interpreted, but unquestionably have some suggestive value for further investigation. For these initial experiments the author used a group of patients whose pathology was well understood. The recorded waves of patterns showed nothing characteristic for the various pictures of ocular and intracranial pathology but they did vary and perhaps with a larger series would fall into more definite groups. The readings were taken for both voluntary and involuntary eye movements with the eyes opened and closed. The results, although admittedly nebulous, show promise of future usefulness and bid fair to be of real diagnostic value in ocular irregularities as well as in intracranial pathology. Morris Kaplan.

Mastrangelo, Giuseppe. **Complete total external ophthalmoplegia with preservation of reflex movement of elevation to corneal stimulus.** Riv. Oto-Neuro-Oft., 1939, v. 16, July-Oct., pp. 311-325.

A man of 58 years, addicted to alcohol and tobacco, developed within a few days paralysis of all external muscles of both eyes, marked ptosis, supraorbital headache, tenderness of both eyes, weakness of the lower limbs, and changes in the tactile sense. However, a stimulus to the cornea provoked elevation of the eye. All symptoms disappeared within a few months. The author believes that the lesion was of toxic-infectious origin and was located in the posterior white commissure and the posterior longitudinal fasciculi at a point where these two formations are contiguous. (Bibliography.)

M. Lombardo.

Meesmann, A. **Contributions to the operative treatment of vertical strabismus.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 156.

Detailed clinical histories of several characteristic examples of vertical squint are discussed. In paresis of the fourth nerve, recession of the inferior rectus of the unaffected eye is the method of choice. In primary and secondary overaction of the inferior oblique, myectomy is the accepted procedure. In the author's opinion early operation, preferably in the third or fourth year of life, is of great importance. C. Zimmermann.

Morgan, O. G. **Convergence weakness.** Brit. Jour. Ophth., 1940, v. 24, Nov., pp. 564-566.

Many people apparently having no convergence at all manifest no symptoms of eyestrain from near work or reading, while others require treatment. The first step in treatment is to explain simply to the patient what is wrong, then to overcome suppression, which is consistently found, and to improve convergence power on the synoptophore. The diploscope can be managed with satisfaction by the patient at home.

D. F. Harbridge.

Mügge, Felix. **The operative treatment of convergent strabismus.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 190.

As the primary operation in convergent strabismus Mügge recommends advancement of the external rectus. This

may be followed, if necessary, by tenotomy of the internal rectus. Any operation should be performed early. The author's results are given in tabular form.

C. Zimmermann.

Sattler, C. H. **The treatment of strabismus and the importance of prism spectacles for restoring binocular visual function.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 182.

Sattler repeatedly emphasizes the importance of the earliest possible treatment of concomitant squint. To obtain coöperation of the two eyes he recommends prism spectacles combined with stereoscopic exercises.

C. Zimmermann.

White, J. W. **The screen test and its modifications, screen-Maddox rod and screen comitance.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 156-160.

White, J. W. **What is the minimum routine examination of muscles?** Arch. of Ophth., 1940, v. 24, Dec., pp. 1113-1122.

The routine examination outlined by the author includes: history, vision, refraction, accommodation, deviation for distance, deviation for near, deviation in the six cardinal fields, and convergence near point. Each of these points and their application is discussed and the norms indicated. The author states that the determination of these points is all that is necessary to a diagnosis, although additional tests may be used for further evidence on a special point.

J. Hewitt Judd.

5

CONJUNCTIVA

Bruens, Egon. **Chemotherapy of gonoblennorrhea neonatorum.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 430.

Bruens describes, with detailed clinical histories, his experience with albucid, a derivative of sulphanilamide, in the treatment of gonorrheal conjunctivitis. Oral administration resulted in disappearance of the gonococci in a few days, but with signs of general intoxication (cyanosis, vomiting, changes of the blood picture), so that this method of administration is not advised. In the newborn the local application of from 10 to 20 percent albucid solutions frees the conjunctiva from gonococci within 24 hours. In addition to the albucid instillations, irrigation with physiologic salt solution every 15 minutes is important.

C. Zimmermann.

Dudinov, O. A. **Slitlamp picture of the reaction of the trachomatous eye to antitrachomatous operations.** Viestnik Opht., 1940, v. 16, pt. 6, p. 458.

A detailed description of the biomicroscopic picture of changes taking place in cornea and transplant after Denig's operation. The immediate clearing of the cornea is thought to be due to the improved circulation brought about by the hyperemia in the veins and arteries of the pannus vessels. Later improvement in the cornea is due to the local effect of the products of inflammatory reaction adjacent to the transplant. The salutary action of the operation on the corneal process ceases with the appearance of cicatricial changes at the operative site. The best results of Denig's operation are in cases of pannus accompanied by extensive cicatricial changes in the upper portion of the bulbar conjunctiva. (Illustrations.)

Ray K. Daily.

East, T., and Savin, L. H. **A case of Gaucher's disease with biopsy of the typical pingueculae.** Brit. Jour. Ophth., 1940, v. 24, Dec., pp. 611-613.

This disease is considered sufficiently rare to justify the clinical and histologic description of a specific case. A thin man, aged 59 years, with a dusky complexion, irregular areas of brownish pigmentation on the face, a huge spleen, and an enlarged liver, presented on either side of the corneae brownish triangular pingueculae. The microscopic findings of the biopsy are described. (Figure, references.)

D. F. Harbridge.

Gekker, I. P., and Skvirskaja, Z. M. **Koch-Weeks conjunctivitis.** Viestnik Opht., 1940, v. 16, pt. 6, p. 472.

In the Dnepropetrovsk region Koch-Weeks conjunctivitis constitutes 30 percent of all ocular inflammations. Some cases in very young children run a febrile course with general malaise and a fibrinous conjunctival exudate, but in general the course of the affection is shorter than in localities with warmer climates. Ray K. Daily.

Graue y Glennie, Enrique. **Surgical treatment of symblepharon.** Boletin del Hosp. Oft. de Ntra. Sra. de la Luz, 1940, v. 1, July-Aug., pp. 100-105.

A square flap of skin, almost as long as the eyelid, and (in the case of symblepharon of the lower lid) extending down over the lower rim of the orbit, is utilized to cover the raw surface inside the lower lid where it has been separated from the eyeball. For the raw surface on the eyeball the author uses either healthy conjunctiva of the same eye, or conjunctiva from another eye, or mucous membrane of the lip or vagina. The defect on the skin surface of the lid is covered by sliding upward a second area of skin dissected from the cheek. A similar method can be used for the upper lid. Difficulties and complications are not discussed.

W. H. Crisp.

Kisen, E. G. **Erythema nodosum with involvement of the conjunctiva.** Viestnik Opht., 1940, v. 16, pt. 6, p. 506.

Kisen reviews the six cases recorded in the literature and reports one case. In all the cases there was a selectivity for the bulbar conjunctiva of the palpebral fissure. In four cases there were conjunctival nodules and in three there was an exudative conjunctivitis. In the author's case there was a history of repeated rheumatism and angina, and an attack of angina had preceded the attack of erythema nodosum. Hemolytic streptococci were isolated from the throat and conjunctiva. The author believes that allergy forms the basic factor in etiology, the conjunctiva becoming allergic to the streptococcus.

Ray K. Daily.

Lehrfeld, L., and Breisacher, C. F. **A case of trichinosis presenting chemosis of the bulbar conjunctiva.** Jour. Amer. Med. Assoc., 1940, v. 115, Nov. 23, p. 1794.

A case of trichinosis with chemosis of the bulbar conjunctiva is described in detail. The importance of a blood count in any case of corneal edema presenting a waxy-yellow appearance, without apparent cause, cannot be overemphasized. George H. Stine.

Maisel, I. D. **Technique of the pterygium operation.** Viestnik Opht., 1940, v. 16, pt. 6, p. 511.

The author's modification of McReynold's operation consists in the excision of a strip of conjunctiva between the limbus and the upper margin of the head of the pterygium. This, the author claims, brings healthy conjunctiva in contact with the limbus.

Ray K. Daily.

Pillat, A. **The local effect of concentrated "albucid" solution in gonoblen-**

norrhea of the newborn. Wiener klin. Woch., 1940, v. 53, Oct. 6, pp. 806-808.

Gonoblennorrhea of the newborn may be cured in a surprisingly short time by local use of a 10-percent albucid solution, a sulphanilamide preparation. The experiments leading to this conclusion were carried out in the eye clinic of the University of Graz. Studies on the effect of this treatment in gonoblennorrhea of the adult are under way, but no definite conclusions have been reached. Treatment of the newborn consists in dropping a 10-percent solution of albucid into the conjunctival sac every half hour, and irrigation of the conjunctival sac with normal saline solution every 15 minutes, day and night. The gonococci usually disappear from the palpebral and bulbar conjunctiva in one or two days and it is suggested that the treatment be continued for 24 hours after the first negative bacteriologic examination. Neither local nor general toxic symptoms have been noted after the local use of albucid up to a concentration of 30 percent.

Bertha A. Klein.

Puglisi-Duranti, G., and Rebaudi, F. **Rhinogenous conjunctivitis.** Riv. Oto-Neuro-Oft., 1939, v. 16, July-Oct., pp. 335-344.

The authors discuss theories concerning the action mechanism of the conjunctival reflex phenomena originating in the nose. Eight cases are reported of young men in the twenties each of whom showed recurrent symptoms of conjunctival inflammatory reaction together with a nasal stenosis. Turbinectomies or the application of cocaine and adrenalin resulted in improvement of or recovery from the conjunctivitis. M. Lombardo.

Smith, J. E., Julianelle, L. A., and Gamet, J. H. **Sulphonamide therapy of trachoma.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 174-185.

Spaski, V. I. **Preliminary communication on the use of embryonal tissue for plastic operations.** Viestnik Opht., 1940, v. 16, pt. 6, p. 446.

A report of two cases of Denig's operation for severe trachomatous pannus, in which a part of the embryonal cord, preserved on ice, was used instead of mucous membrane from the lip. The result was restoration of the transition folds and of the corneal transparency. Embryonal tissue was also used effectively to fix the transplant in keratoplasty. Ray K. Daily.

Steinberg, I. R., Charosky, L., and Landaburu, J. J. **A case of conjunctival diphtheria without pseudomembranes.** La Semana Med., 1940, v. 47, Dec. 19, p. 1394.

A girl aged four years awoke one morning with the left eye closed and the lashes glued together. The history did not point to any contact with a case of diphtheria of the throat. There was a febrile reaction but the general condition was good. There was intense conjunctival congestion in the left eye, and to a slighter degree in the right. The conjunctival secretion was a creamy yellow. There was abundant secretion from the nose, with excoriations, and the fauces showed a diffuse reddening. On two successive days the Loeffler bacillus was demonstrated upon examination of the conjunctival discharge. The condition yielded rapidly to a single dose of 50,000 units of antidiphtheric serum. W. H. Crisp.

Tichova, V. A. **Local application of cod-liver oil in restoration of the con-**

junctival sac. Viestnik Opht., 1940, v. 16, pt. 6, p. 426.

The author's procedure consists in making two or three incisions in the cicatricial tissue of the conjunctival sac, and then packing it tightly with gauze saturated with cod-liver oil. The cod-liver oil stimulates growth of the conjunctival epithelium which covers the stretched raw surfaces. A report of three cases illustrates the effectiveness of the procedure. In order to confirm the effect of cod-liver oil, Tikhova conducted a laboratory investigation on rabbits, using vaseline packing in the control cases. Microscopic sections of the newly formed cicatricial tissue showed that epithelization was faster and smoother in cases packed with cod-liver oil. The cicatricial tissue in the cases packed with cod-liver oil consisted of young highly vascular connective tissue; in the vaseline-packed cases it was coarse and poor in vessels. (Illustrations.) Ray K. Daily.

Wilson, R. P. **The pathology of trachoma.** Acta Ophth. Orientalia, 1940, v. 2, Jan., p. 1.

The author describes the manifold histopathologic changes found in trachoma. He considers trachoma as a chronic inflammatory disease due to a virus infection which is probably represented by the elementary granules of the Prowazek-Halberstaedter body.

R. Grunfeld.

Wright, R. E. **Trachoma (experimental data of the Government Ophthalmic Hospital, and the King Institute of Preventive Medicine, Madras, 1935, 1936, 1937).** Brit. Jour. Ophth., 1940, v. 24, Nov., pp. 547-560.

In the first phase of this study (see Amer. Jour. Ophth., 1935, v. 18, p. 988) the main objective was to show that unfiltered trachoma material reproduced the disease in the normal human conjunctiva and produced lesions on the chorio-allantoic membrane of the chick. Attempts to isolate a virus as the active infective agent of trachoma were not conclusive. In the second phase of the research (1935 to 1937), the power of unfiltered trachoma material to infect the human conjunctiva was reinvestigated, and again the results were inconclusive, successful infection of the normal human conjunctiva resulting only seven times in 23 attempts. (Tables.) D. F. Harbridge.

Zur Nedden, M. **Observations on 500 cases of keratoconjunctivitis epidemica.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 424. (See Section 6, Cornea and sclera.)

6

CORNEA AND SCLERA

Castroviejo, Ramón. **Keratoplasty: comments on the technique of corneal transplantation; source and preservation of donor's material; report of new instruments.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 1-20; and Feb., pp. 139-155.

Corboy, P. M. **Van der Hoeve's syndrome.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 57-60.

Lugossy, Gyula. **Bilateral total degeneration of the cornea in vernal catarrh.** Orvosi Hetilap, 1940, v. 84, no. 36, p. 467.

While being treated in the hospital for bilateral vernal catarrh, a ten-year-old boy developed on the upper and lower corneal margins gray gelatinous thickenings 1.5 mm. wide. At the time the boy left the hospital his vision was O.D. 5/20 and O.S. 5/50. While at

home the eye condition was treated as trachoma. When he was readmitted to the hospital ten months later vision was reduced to hand movements. The corneae seemed to be entirely degenerated, appearing as diffusely opaque discs of bluish-gray color with stippled and uneven surfaces, lusterless, and with loss of transparency. The unevenness of the surfaces was enhanced by unevenly dense depositions of cells, which histologically proved to be proliferating epithelial and conjunctival cells.

R. Grunfeld.

Meyer, G. P., and Reber, J. **A case of corneal ulcer associated with lymphogranuloma venereum.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 161-163.

Mould, W. L. **Corneal opacities in the Alaskan Eskimo.** Arch. of Ophth., 1940, v. 24, Nov., pp. 972-974.

Bilateral extensive opacities of the cornea are relatively common in the Alaskan Eskimos. Epiblepharon is also common, and in some cases the condition is sufficiently developed to turn the cilia of the lower lid backward against the globe and cause erosions of the cornea. Further study will be required to demonstrate scientifically a relation between these two factors.

J. Hewitt Judd.

Petrosiantz, E. A. **The sensitivity of corneal scars.** Viestnik Opht., 1940, v. 16, pt. 6, p. 436.

The sensitivity of one hundred corneal leucomata of various etiologies was studied by means of Frey's hair. The tabulated data show reduced tactile and pain sensitivity proportionate to the density of the leucoma. A corneal opacity of varying density has a different sensitivity in its various portions. Tactile sensitivity and pain sensitivity are not involved to the same extent; in opacities following parenchymatous keratitis the interval between tactile sensitivity and pain sensitivity is greater than in cicatricial opacities.

Ray K. Daily.

Radzichovskii, B. L. **Local application of cod-liver oil in keratomalacia.** Viestnik Opht., 1940, v. 16, pt. 6, p. 434.

Thirteen children with keratomalacia, complicating severe intestinal disturbances, were treated with local applications of cod-liver oil. On the basis of this clinical experience the author concludes that cod-liver oil corrects a local avitaminosis, has a bactericidal effect, and stimulates corneal metabolism. Ray K. Daily.

Spaski, V. I. **Preliminary communication on the use of embryonal tissue for plastic operations.** Viestnik Opht., 1940, v. 16, pt. 6, p. 446. (See Section 5, Conjunctiva.)

Torres Estrada, A. **Surgical treatment of keratoconus.** Boletin del Hosp. Oft. de Ntra. Sra. de la Luz, 1940, v. 1, July-Aug., pp. 106-117.

The procedure is described as being modified from that recommended by Fox. A semilunar piece is excised from the lower part of the cornea, and the corneal edges are approximated by means of a corneal mattress suture which has been inserted previously. Interrupted corneal sutures are added to complete the corneal union. The iris is not disturbed. W. H. Crisp.

Trantas, A., and Trantas, N. **Dystrophic marginal keratoleptynsis (Terrien's disease) with cavity.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Oct.-Dec., p. 270.

Of six cases of keratoleptynsis seen by the authors, this is the second to show intracorneal cavities. In spite of the corneal lesions, corrected vision was 0.8 in each eye. George A. Filmer.

Zur Nedden, M. **Observations on 500 cases of keratoconjunctivitis epidemica.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 424.

In 1938 and 1939 (see Amer. Jour. Ophth., 1939, v. 22, Aug., p. 927) the author reported on 200 cases of epidemic superficial punctate keratitis. The disease is characterized by chemosis and swelling of the lids and the preauricular glands. The superficial layers of the cornea show many small round spots with punctate infiltrations. No bacteria could be proved in smears and inoculations in the eyes of rabbits were not successful, but the contagious character of the condition was indicated by its familial occurrence. The spots on the cornea may persist for more than two years. The author discounts the etiologic importance of the diphtheria bacillus as claimed by Behr.

C. Zimmermann.

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Bellows, J. G., and Chinn, H. **Regeneration of the aqueous.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1144-1166.

A method is described whereby aqueous humor may be collected through a cannula for long periods of time without clotting of the plasmoid fluid after intravenous injection of chlorazol fast pink, an anticoagulant of blood. By this method the flow of regenerated aqueous was determined for intervals ranging from five minutes to 16 hours. A rapid diminution of the rate of flow was observed for approximately two hours after paracentesis, a comparatively constant flow for the next three to five hours, and finally a slow decline until the completion of the experiment. Various explanations for these findings are discussed. The specific gravity of the aqueous increased sharply after paracentesis and reached a maximum within five to 25 minutes. With a low blood pressure, low values for specific gravity were usually obtained. The flow of aqueous directly followed changes in blood pressure produced by various drugs. Clamping the carotid artery decreased the flow of aqueous from the eye supplied by it and release of the artery produced a resumption of normal flow. Epinephrine hydrochloride or atropine sulphate injected retrobulbarly decreased the flow of aqueous. The specific gravity of the plasmoid aqueous after injection of epinephrine showed a slower rise after paracentesis than did that from the control eye. The results with histamine were variable, but in general its retrobulbar injection increased the flow. Physostigmine salicylate, mecholyl chloride, and prostigmine methylsulphate each produced an increased flow when given retrobulbarly. The effectiveness of these drugs were in the order listed. Procaine hydrochloride, ergotamine tartrate, secretin, and urogastrone gave negative results. Systemic pyrexia delayed the rapid decrease in flow normally obtained. Hypotonic, isotonic, and hypertonic solutions given separately were without action. The injection of isotonic saline solution followed by the injection of hypertonic saline solution increased the flow of aqueous. Local irritants injected retrobulbarly were ineffective except in the case of benzene, which produced a marked and prolonged stimulation of the flow. The intraocular injection of sodium fluoride

produced an increased capillary permeability, as indicated by the penetration of dye given intravenously and by increased values for specific gravity. The effects of these drugs and conditions on the flow of aqueous are discussed on the basis of local and general circulatory changes and the secretory activity of the ciliary body. J. Hewitt Judd.

Cutuly, E. **Implantation of hormonal substances in the anterior chamber of the eye of rats.** Proc. Soc. Exper. Biol. and Med., 1940, v. 45, Nov., p. 659.

Pellets of testosterone propionate, stilbestrol, pregnant-mare serum, and progesterone were implanted in the anterior chambers of rats which had been castrated. At various later periods no trace of the substance could be found in the aqueous while in the body each substance had produced effects characteristic of its normal action.

Morris Kaplan.

Duggan, W. F. **Vascular basis of uveal disease. Acute anoxia as the fundamental pathologic physiology.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1123-1138.

Eleven cases of acute uveal disease (exclusive of choroiditis) are reported in which vasodilator therapy seemed to give marked and rapid improvement. The similarity between iritis, iridocyclitis, and cyclitis, or between acute choroiditis, acute spastic closure of the central retinal artery or one of its branches, and acute retrobulbar neuritis is based on the fundamental pathology and pathologic physiology of the various lesions in each group. The superficial differences between these clinical lesions depend on the anatomic structure of the tissues involved. The early changes consist of arteriolar constriction, capillary dilatation, and increased capillary permeability with resulting perivascular edema and round-cell infiltration. The early pathologic changes are due to capillary anoxia, which in turn causes tissue anoxia in special areas. The late pathologic changes are usually due to the replacement of acute focal necroses by scar tissue. Histamine or a histamine-like body is suggested as a likely etiologic agent because (1) histamine constricts arterioles and both dilates and increases the permeability of capillaries; (2) histamine may be responsible for cases ascribed to allergy, focal infection, or cold; and (3) histamine is set free when tissue is traumatized. Hypersensitivity of one or more arteriolar and capillary units to histamine or a histamine-like body explains the focal nature of these lesions. Arteriolar and capillary hypersensitivity may be due to an excess or deficiency of epinephrine and the other hormones, to a relative avitaminosis, or (probably) to an age factor. A relative lack of histaminase may be the factor whereby histamine or a histamine-like body is able to enter the circulation in one region of the body and act on histamine-sensitive cells at some remote point in the body. Since sympathetic ophthalmia differs only quantitatively from the ordinary case of iridocyclitis, a new theory is offered for its origin and development. The theory is based on the pathologic and clinical features of this condition, and satisfactorily accounts for the atypical cases not preceded by a perforating injury. The giant cells and epithelioid cells are merely the reaction of uveal tissue cells to prolonged anoxia. A similar mechanism would explain cases of sarcoid, Hodgkin's disease, and many diseases attributed to viruses. While the causation is often obscure in uveal disease, the arteriolar and capillary

changes are the final common pathway for all lesions attributed to focal infection, to allergy, and to a lack of the different vitamin-B factors (particularly thiamine and nicotinic acid). Treatment directed specifically toward the vascular pathologic process has produced excellent therapeutic results by relieving the tissue anoxia.

J. Hewitt Judd.

Gamble, R. C. **A case of sympathetic ophthalmia treated with sulphanilamide.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 49-51.

Klien, B. A. **Pseudomelanomas of the iris.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 133-138.

Kronfeld, P. C. **The limits of tyndallimetry in the anterior chamber.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 51-57.

Lijo Pavia, J. **Absence of the retina and choroid. Total coloboma.** Rev. Oto-Neuro-Oft., 1940, v. 15, March, p. 75. (See Section 10, Retina and vitreous.)

Lijo Pavia, J. **Bilateral congenital corectopia.** Rev. Oto-Neuro-Oft., 1940, v. 15, Jan., p. 17.

The third of a series of papers on congenital eye defects, this article deals with eccentricity of the pupil. A case is reported of corectopia in a seven-year-old congenital luetic in which secondary glaucoma of the left eye was a complicating factor. The case was followed over a three-year period with marked visual improvement under antiluetic therapy. Edward P. Burch.

Lijo Pavia, J. **Congenital aniridia with three observations.** Rev. Oto-Neuro-Oft., 1939, v. 14, Nov., p. 259.

A discussion of congenital aniridia with particular emphasis on the frequency of accompanying ocular defects is supplemented by three case reports. The article is profusely illustrated.

Edward P. Burch.

Marback, Hector. **A rare form of persistent pupillary membrane.** Folia Clin. et Biol., 1940, v. 12, no. 6, p. 203.

The anomaly occurred in the right eye of a 16-year-old boy and consisted of a strand of triangular form springing from the collarette between the one and two-o'clock positions and inserted on the anterior surface of the lens, near the anterior pole. The strand had all the appearances of iris tissue except that the surface was smooth. The point of insertion appeared tendinous and was surrounded by pigment granules. Neither the form nor the reaction of the pupil was affected. The literature is reviewed and the derivation of the anomaly is explained on embryologic grounds. E. M. Blake.

Ramsay, A. M. **An analogy between the intrinsic muscles of the eye and the muscle of the heart.** Glasgow Med. Jour., 1940, v. 134, Oct., p. 115.

The author maintains that similar structures behave similarly wherever they are found in the body. He mentions the pain which is the basis of "photophobia" in the eye and of "angina" in the heart and which results from spasmodic contraction of the involuntary muscles of the respective organs. Photophobia is discussed at length. The similarity in functional activity and reaction to drugs, strain, and toxemia from various sources is described, explained, and amply illustrated by occurrences common to all physicians. F. M. Crage.

Sachs, E., and Heath, P. **The pharmacological behavior of the intraocular**

muscles. 3. "Cholinergic" behavior of the dilator iridis. Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 34-39.

8

GLAUCOMA AND OCULAR TENSION

Benedict, W. L. **Sclerocorneal trephining (Elliot's operation).** Arch. of Ophth., 1940, v. 24, Dec., pp 1100-1112; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1940, 100th mtg.

The literature is reviewed and the anatomy of the relation of Tenon's capsule to the sclera and conjunctiva is discussed. A modification of the Elliot operation is described in which the relation between Tenon's capsule and the conjunctival epithelium is not disturbed and the cornea is not split. Wing cuts in Tenon's capsule eliminate tension and lessen the danger of buttonholing the flap. This modification provides safety from infection and obviates constriction of the flap and formation of a vesicle over the fistula. (Discussion.)

J. Hewitt Judd.

Bolgob, P. I. **The effect of high-frequency currents on glaucoma.** Viestnik Opht., 1940, v. 16, pt. 6, p. 421.

The conclusions are made on the basis of 121 cases in which this form of therapy was applied because miotics alone were inadequate to control the intraocular tension, and the patients refused surgery. The data show that high-frequency currents were ineffective in reducing intraocular tension to a lower level than that achieved by miotics. High frequency alone was entirely ineffective in absolute glaucoma, in some cases even producing a rise in tension; it reduced the tension in chronic and subacute glaucoma, but had no effect on the simple and absolute types. In postoperative cases, high-frequency treatment was more effective than in unoperated cases.

Ray K. Daily.

Gabriélidès, C. **The Blascovics cyclodialysis. Results of and comments on the method.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Oct.-Dec., p. 256.

The author has used this procedure in chronic glaucoma, and especially in cases of aphakia with secondary glaucoma. He states that the principal inconvenience of the method lies in postoperative deposition of pigmented precipitates on the anterior lens capsule.

George A. Filmer.

Sondermann. **The importance of normal intraocular pressure in therapy.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 486.

A favorable blood supply to a diseased organ is the first and most important condition for a good and speedy recovery. In all serious affections of the eye we must consider that even normal intraocular pressure involves a state of congestion of the veins unfavorable for healing. By artificial lowering of the intraocular tension we may reduce this congestion and thus increase the healing tendency. The author showed experimentally that by opening the anterior chamber the pressure in the vortex veins might be reduced to half and the blood supply thus considerably increased. In corneal ulcers healing may be stimulated through abolition of the anterior chamber by trephining. C. Zimmermann.

Stokes, W. H. **Hereditary primary glaucoma.** Arch. of Ophth., 1940, v. 24, Nov., pp. 885-909.

The previously published pedigrees of hereditary glaucoma occurring in three or more generations are sum-

marized and discussed and thirty cases occurring in five generations are reported. The disease appeared to be a simple dominant and not sex-linked. Consanguinity was not present. The age of onset varied in different families from early youth to adult life. Liability to transmission by the two sexes was equal. It usually, though not always, appeared in a chronic form. The incidence of myopia in hereditary glaucoma was sufficiently high to suggest that the hypertension had been a factor in producing it. The only permanently good results were obtained in persons in whom one of the fistulizing operations was performed. The best results were obtained when the operation was performed early while the glaucoma was still in the compensatory stage and before irreversible secondary anatomic and pathologic changes had occurred. J. Hewitt Judd.

9

CRYSTALLINE LENS

Allen, J. H., and Barer, C. G. **Cataract of dystrophia myotonica.** Arch. of Ophth., 1940, v. 24, Nov., pp. 867-884.

The authors review the literature and report 22 cases found in 16 families during a period of eight years. Lenticular changes were observed in each case in which biomicroscopic examination was done, even though several of the patients had observed no visual disturbance. These changes consisted of numerous minute grayish-white opacities in the anterior and posterior cortex, close to but not immediately under the capsule, and interspersed with iridescent crystals of all hues. Some were diffusely scattered, others concentrated along the suture lines. On repeated examination the opacities were observed to increase. Other ocular manifestations of the disease in the order of frequency are: ptosis, ectropion, and enophthalmos. While dystrophy myotonica is rare, it probably is not as rare as the case reports in the literature would indicate. Typical findings are shown in photographs.

J. Hewitt Judd.

Blaess, M. J. **Suction cataract operation.** Jour. Internat. College of Surg., 1941, v. 4, Feb., p. 37.

The Barraquer suction technique for intracapsular extraction of cataract is described and the various steps illustrated by photographs. (6 photographs.) George H. Stine.

Lijo Pavia, J., and Cerboni, F. C. **Bilateral atypical coloboma of the lens.** Rev. Oto-Neuro-Oft., 1939, v. 14, Dec., p. 289.

The literature of coloboma of the lens is briefly reviewed and a case of the authors is added to the literature. The patient was a 15-year-old boy whose family history revealed no ocular findings of importance. He was highly myopic in each eye. The site of the coloboma is diagrammatically represented. The eyegrounds exhibited a marked atrophic chorioretinitis.

Edward P. Burch.

Mitchell, H. S., Cook, G. M., and Henderson, M. D. **Anticataractogenic action of certain nitrogenous factors.** Arch. of Ophth., 1940, v. 24, Nov., pp. 990-998.

Since it had been found that rations high in protein were protective, and those low in protein hastened the lenticular changes due to galactose, various nitrogenous factors were tested and the results herein reported lead the authors to believe that the protective agent is nitrogenous and that it may be some specific amino acid or

group of amino acids. An enzymic casein hydrolysate exerted the same protective action as commercial casein. Neither of the sulfhydryl amino-acids cystine and methiomine seemed to offer specific protection against galactose cataract when observed with a paired feeding technique. The simpler nitrogenous compounds urea and choline were not effective substitutes for protein in its anticataractogenic capacity. Deaminized casein was more protective and heated casein less protective than commercial casein. The significance and possible application of these findings are discussed. J. Hewitt Judd.

Páez Allende, Francisco. **Extraction of the crystalline lens without iridectomy.** La Semana Med., 1941, v. 48, Jan. 30, p. 249.

Describes and illustrates fifteen cases in which the author removed the lens without iridectomy and without subsequent hernia of the iris; some operations being performed by suction, others by intracapsular extraction with forceps, others by extracapsular extraction. W. H. Crisp.

Rieken, Hans. **Dislocation of the lens as an isolated symptom in the clinical picture of arachnodactyly.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 482.

In a 9-year-old boy whose family was afflicted with hereditary arachnodactyly, bilateral ectopia of the lens was present but no other symptoms of the clinical picture. As the mother and other children showed a marked Marfan's complex in addition to the dislocation of the lens, the ectopia is considered as an isolated symptom of arachnodactyly. C. Zimmermann.

Rolett, D. M. **Unusual changes in the lens following trauma. Origin and treatment.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1244-1254. (See Section 16, Injuries.)

Salit, P. W. **Total lipid and cholesterol content of cataractous and sclerosed human lenses.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 191-195.

Velhagen, K., Jr. **Cases of diabetic cataract.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 503.

Three cases of mild, moderately severe, and latent diabetes are described as showing subcapsular opacities, very marked subcapsular delineation of fibers, and punctate and floccular opacities. The course indicated that, in spite of the advanced age of the patients (45, 50, and 65 years respectively), true diabetic opacities of the lens existed. The special changes were observed for only a few days. C. Zimmermann.

10

RETINA AND VITREOUS

Brown, W. M., and Whitney, E. L. **Peripheral vascular picture in retinitis pigmentosa.** Arch. of Ophth., 1940, v. 24, Nov., pp. 984-989.

In nine cases of retinitis pigmentosa the peripheral vascular picture at the limbus and at the nail bed was studied by biomicroscopy and the occlusion index was determined. All cases presented unmistakable evidence of a generalized peripheral vascular disturbance of the capillary type. A summary of these findings is presented in a table. The altered metabolism at the chorioretinal threshold due to this capillary abnormality was sufficient to produce anoxia and subsequent death of the neuroepithelium. J. Hewitt Judd.

Lijo Pavia, J. **Absence of the retina and choroid. Total coloboma.** Rev. Oto-Neuro-Oft., 1940, v. 15, March, p. 75.

The author reports a unique case of bilateral absence of retina and choroid in a seven-year-old child. The condition could not be classified as either choroideremia or gyrate atrophy of retina and choroid. There was total absence of all retinal structures, choroid, and optic papilla. The eyes were normal externally and the mediae were clear. Blood vessels transversing the ophthalmoscopic field could be made out. Edward P. Burch.

Viramontes, Luis. **Detachment of the retina and industrial accidents.** Boletin del Hosp. Oft. de Ntra. Sra. de la Luz, 1940, v. 1, July-Aug., pp. 118-124.

The author touches briefly on the doubts which frequently exist as to whether detachment results from working conditions or from systemic disease. W. H. Crisp.

Wetzel, J. O. **Pseudoglioma of the retina.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 164-173.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Fazio, C., and Farina, P. **Blood-vessel structure of optic nerve, chiasm, and optic tract.** Riv. Oto-Neuro-Oft., 1940, v. 17, Jan.-Feb., pp. 38-54.

The disposition of the vascular formation in these structures was studied in 30 human cadavers. In each a parallelism existed between the vessel and nerve structures. (21 figures.) M. Lombardo.

Hausman, Louis. **The surgical treatment of syphilitic optic atrophy due to chiasmal arachnoiditis.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 119-132.

Proksch, Marie. **Tobacco amblyopia superimposed on myopic macular changes.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 507.

A man of 53 years with myopic macular changes developed sudden visual disturbance with marked central scotoma. Excessive smoking was discontinued and after a month the vision improved. C. Zimmermann.

12

VISUAL TRACTS AND CENTERS

Halstead, W. C., Walker, A. E., and Bucy, P. C. **Sparing and nonsparing of "macular" vision associated with occipital lobectomy in man.** Arch. of Ophth., 1940, v. 24, Nov., pp. 948-966.

In the two cases of occipital lobectomy considered in this report it was found that the patients remained intelligent, coöperative, and capable of accurate fixation, thus making possible careful examination of the central visual fields. Right hemianopsia with noncongruous maximal sparing of 2.5 degrees for brightness and color was found under test conditions which provided direct control of accuracy of fixation in the instance of the patient with the left occipital lobectomy. Sparing of 1.25 degrees for form was also found in this patient. Left homonymous hemianopsia with splitting of the macula was found in the instance of the patient with a right occipital lobectomy. This had been confirmed repeatedly during the six months after the operation. In the first case complete removal of all striate cortex was verified histologically. In the second, little if any striate cortex remained after lobectomy. The paradox presented by these cases does not seem open to solution in terms of any of the present hypotheses concerning the arrangement of the visual system. Yet the two cases reported, both in terms of histologic

control of the lesion and in analysis of the visual functions, show that the paradox is real and not apparent. This indicates that the problem of cortical projection of the macula is not yet adequately solved. (Discussion.)

J. Hewitt Judd.

Lillie, W. I. **Prechiasmal syndrome produced by chronic local arachnoiditis.** Arch. of Ophth., 1940, v. 24, Nov., pp. 940-947; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1940, 100th mtg.

Prechiasmal and chiasmal inflammatory lesions which produce a slowly progressive syndrome suggestive of tumor may be broadly classified as basal gummatous meningitis, and chronic local arachnoiditis. Three cases are reported in which the correct site of the lesion was diagnosed ophthalmologically and the correct pathologic process predicted preoperatively by the encephalographic findings. Whenever a prechiasmal or chiasmal syndrome is associated with a normal roentgenographic picture, chronic local arachnoiditis should be suspected and encephalographic studies made. This procedure will prove invaluable in indicating the correct pathologic process before surgical treatment is instituted. Chronic local arachnoiditis responds favorably only to surgical intervention, and an operation should be done without delay. (Discussion.)

J. Hewitt Judd.

Weinberger, L. M., Adler, F. H., and Grant, F. C. **Primary pituitary adenoma and the syndrome of the cavernous sinus.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1197-1236; also Sec. on Ophth., 1940, 100th mtg.

Fourteen cases of primary pituitary adenoma presented unusual neurologic and neuro-ophthalmologic clinical pictures. They are divided into three groups: (1) those in which the disturbances referable to the ocular and trigeminal nerves composed the exclusive neurologic picture; (2) those in which the symptoms referable to the ocular and trigeminal nerves dominated the clinical picture but in which there were some evidences of implication of the optic chiasm; and (3) those in which the disturbances referable to the ocular and trigeminal nerves were an important part of the clinical symptoms but in which there were unequivocal visual-field defects indicating an intrasellar lesion. The disturbances referable to the ocular and trigeminal nerves in these cases were accounted for by the implication of the cavernous sinus. It is shown that occasionally pituitary adenomas grow laterally and that this mode of growth may produce the clinical picture of a lesion in the sphenoid fissure rather than the classic chiasmal syndrome. The anatomic structure of the sella turcica and its surroundings which results in the lateral growth of the tumors with involvement of the structures contained in the cavernous sinus is discussed. The conditions to be differentiated from the pituitary adenoma are considered. The changes in the usual surgical technique when a lateral extrusion of a pituitary adenoma has been diagnosed are discussed. (Discussion.)

J. Hewitt Judd.

13

EYEBALL AND ORBIT

Aird, R. B. **Experimental exophthalmos and associated myopathy induced by the thyrotropic extract.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1167-1178.

The experimentally produced exophthalmos developed in the refractory period following acute thyrotoxicosis produced by the action of the thyro-

tropic principle on the thyroid gland and progressed slowly in an irregular manner. After several months of injection, the exophthalmos was found to persist in spite of discontinuance of injections, and even under narcosis or after death. Myopathy of the extraocular muscles was observed in the guinea pigs in which exophthalmos had developed after injection of the extract. This change was sufficient to account for the degree of exophthalmos observed as well as its permanence following prolonged treatment. No other satisfactory explanation for the exophthalmos was found. Qualitatively, the experimental myopathy was consistent with the changes found in the extraocular muscles of human patients afflicted with malignant exophthalmos. (Discussion.) J. Hewitt Judd.

Ellett, E. C. **Unilateral exophthalmos.** Jour. Amer. Med. Assoc., 1941, v. 116, Jan. 4, p. 1.

The different causes of unilateral exophthalmos are discussed and illustrated by cases. (23 case reports, 42 illustrations.) George H. Stine.

Lemoine, A. N. **Pseudotumors of the orbit (inflammatory).** Jour. Missouri State Med. Assoc., 1941, v. 38, Jan., p. 15.

This report is written as a plea for biopsy examination of all orbital tumors before radical surgery is done. Two cases are reported in which the history, signs, and symptoms were identical with those of malignant neoplasms. After exenteration had been decided upon but before it was done, biopsies were taken and revealed both growths to be pseudotumors. The causes are given as foci of infection, either by continuity or metastasis, tuberculosis, late syphilis (gumma), or trauma.

Morris Kaplan.

Sniderman, H. R. **Cirsoid aneurysm of the orbit.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1190-1196.

Sniderman describes two cases. The first case presented multiple congenital cirsoid aneurysms with orbital involvement which improved after ligation of the external carotid artery and superior thyroid artery. The second had a cirsoid aneurysm of the orbit following trauma which was completely relieved after ligation of the external carotid artery, occlusion of the internal carotid artery with an aluminum band, and local extirpation of some of the vessels of the lid. The vascular supply of the orbit and lid is briefly reviewed. (Photographs.) J. Hewitt Judd.

Torres Estrada, Antonio. **Dermoid cysts of the orbit penetrating to the anterior cerebral fossa.** Boletin del Hospital Oft. de Ntra. Sra. de la Luz, 1940, v. 1, July-Aug., pp. 129-132.

The patient was a woman of 62 years, who stated that the tumor had been present since birth. Operation was performed through an incision along the line of the eyebrow. The roof of the orbit had been destroyed in a circular area about 3 cm. in diameter. The cyst extended into the anterior cerebral fossa, pushing aside the dura mater, and there were openings into the frontal and anterior ethmoidal sinuses. A drainage tube was left in position for a few days. The wound healed by first intention, and the eye returned to its normal position. W. H. Crisp.

14

EYELIDS AND LACRIMAL APPARATUS

Busacca, Archimede. **A simple method of treating dacryocystitis in the newborn.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1256-1257.

Good results in six cases have been

obtained by use of an injection of two c.c. of bouillon containing the Besredka filtrates through a cannula into the sac with as much pressure as possible. The irrigations are repeated every second day. J. Hewitt Judd.

Cramer, F. E. K., and Balza, J. **Presentation of new burrs for the operation of dacryocystorhinostomy**. La Semana Med., 1941, v. 48, Jan. 30, p. 294.

Four burrs are described and illustrated, in two types, conical and inverted conical.

Klemens, F. **Blepharochalasis, thyroid disease, and double lip.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 474.

One case of blepharochalasis with typical double lip and two cases of blepharochalasis with thyroid disease are described. All showed a prolapse of the palpebral lacrimal gland. Endocrine disturbances of the thyroid glands and ovaries are assumed as probable etiology. C. Zimmermann.

Spaeth, E. B. **Congenital colobomata of the lower lid.** Amer. Jour. Ophth., 1941, v. 24, Feb., pp. 186-190.

Tiscornia, A., and Nano, H. M. **Acute bilateral primary palpebral dacryoadenitis.** La Semana Med., 1940, v. 47, Sept. 12, p. 575.

The patient was a boy of eight years, who came on account of a rapidly developing swelling beneath the skin of the outer half of the upper eyelid. There were systemic symptoms, and in the course of two or three days fluctuation developed. After evacuation of pus through surgical incisions, the general and local symptoms rapidly disappeared. Bacteriologic study showed the presence of staphylococci, streptococci, pneumococci, and Morax diplobacilli.
W. H. Crisp.

15
TUMORS

Badtke, Günther. **The question of heredity in glioma retinae.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 451.

All cases of glioma treated at the eye clinic of Innsbruck from 1900 to 1940 are reviewed and evaluated. Special attention is paid to the possible role of heredity. Badtke describes three genealogic trees showing hereditary tainting by carcinoma, hydrophthalmos, and mental disease. C. Zimmermann.

Gifford, S. R. **Phakoma retinae and adenoma sebaceum.** Arch. of Ophth., 1940, v. 24, Nov., pp. 967-971.

A man aged 37 years presented an almost white, rounded mass in the retina, 0.5 disc-diameter in size and elevated about 2 diopters, and crossed by several small retinal vessels. There were a few areas of depigmentation with ill-defined borders in the macular area and elsewhere in the fundus. The opposite eye was normal. The patient presented typical adenoma sebaceum of the cheeks and a number of neurofibromata on the shoulders and arms. (Photograph.) J. Hewitt Judd.

Luzsa, Andreas. **Metastases of carcinoma of the mammary gland in both eyes.** Klin. M. f. Augenh., 1940, p. 104, Oct., p. 495.

A woman of 65 years complained of rapid deterioration of the vision of her left eye. Both her parents had died from carcinoma, and two years previously her right breast had been removed with dissection of the axial lymph nodes. Both fundi showed near the discs circumscribed intraocular tumors starting from the choroid. In both eyes the tension was diminished. Enucleation would be indicated only in case of painful secondary glaucoma.
C. Zimmermann.

Pavišič, Zvonimir. **A case of neurofibromatosis of the lids.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 490.

Four years previously a normally developed boy of 11 years had noticed a small red nodule of the skin above the left eyebrow. The nodule grew and extended over the left upper and lower lids. Two years later a tumor of the abdomen had been partially removed. The tumor of the lids had spread in the conjunctiva and a thin pannus covered 4 or 5 mm. of the upper part of the cornea. The lamina cribrosa and papillary vessels were covered by a fine veil. The left orbit was very much enlarged and in consequence stenosis and deformation of the left nasal meatus, ethmoidal cells, and frontal sinus were found. The tumor was removed from the lids and temporal region. It consisted of a conglomeration of nodular nerve loops, secondary to a congenital mesenchymal disturbance of development, with fibrous increase of the endoneurium and thickening and proliferation of the perineurium. C. Zimmermann.

Saradarian, A. V. **Bilateral subconjunctival lymphoid infiltration.** Arch. of Ophth., 1940, v. 24, Nov., pp. 980-983.

A man aged 55 years presented an extensive reddish or salmon-colored sharply demarcated mass which slightly overhung the limbus but did not involve the cornea. At biopsy a noninflammatory subconjunctival tumor of the episclera was easily separated from the normal sclera below. Sections of the mass showed myelocytes, a few plasma cells, and numerous undifferentiated blast cells with occasional reticulum. Numerous blood spaces and collagen fibers were also present. The diagnosis of lymphoma or leukemic nodule was made. J. Hewitt Judd.

Spratt. C. N. **Carcinoma of the lacrimal sac.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1237-1243.

A man aged 66 years presented a swelling over the lacrimal sac with considerable proptosis of the eye. A hard, rounded mass could be palpated over the sac and a hard lobulated mass occupied the inner two thirds of the lower lid. Complete exenteration of the orbit was done and no recurrence had been noted ten months after the operation. Cases reported in the literature are reviewed. The findings are shown in photographs and photomicrographs.

J. Hewitt Judd.

16

INJURIES

Drachman, M., and Friedman, B. **A method of eliminating arcing in the foot switch of an eye magnet.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1255-1256.

By employing a condenser mounted across the switch terminals to by-pass the electric surge around the switch as it is being opened, arcing is prevented. The condenser blocks any inflow of direct current into the magnet. This enables the operator to use a small, convenient foot switch instead of the heavy type usually employed.

J. Hewitt Judd.

Rolett, D. M. **Unusual changes in the lens following trauma. Origin and treatment.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1244-1254.

Five cases of post-traumatic stationary cataract are reported. Two of the cases give a history of perforating injury and three of nonperforating injury. The cataracts in all cases presented a peculiar cobweb-shaped, stationary, central opacity involving similar layers of the lens. The author suggests that this type of cataract forms as a result

of injury to the eye which traumatizes the iris and the ciliary body. An exudate accompanying the hemorrhage into the anterior chamber spreads either over one or both surfaces of the lens. This exudative membrane becomes organized at the poles. At the periphery of the lens the more active circulation of the aqueous clears the lens of the exudate before it becomes organized. The opacities remain local because comparatively only a small portion of the lens is involved and the deeper structures are not injured either directly or indirectly. These changes are shown by means of drawings. (Discussion.) J. Hewitt Judd.

Tatár, Josef. **Contribution to the method of extraction of foreign bodies (nonmagnetic) protruding into the anterior chamber.** Klin. M. f. Augenh., 1940, v. 105, Oct., p. 499.

After discussing the methods of other workers, the author describes and illustrates Kreiker's procedure of introducing a lance-shaped knife behind the foreign body and removing the foreign body with a forceps.

C. Zimmermann.

Torres Estrada, Antonio. **Ocular burns by lime.** Boletin del Hosp. Oft. de Ntra. Sra. de la Luz, 1940, v. 1, July-Aug., pp. 125-128.

To neutralize the particles of lime included within the coagulated tissues, the author utilizes the ready solubility of lime in a solution of sugar. The chemical compound formed is a saccharide of lime extraordinarily soluble in water. The most effective method consists in applying within the conjunctival sac powdered sugar, or even granulated sugar, preferably under local anesthesia. After the first abundant application of sugar, followed by irrigation, a weaker solution of sugar is applied frequently for two or three days. The author further mentions the burns produced by the juice of the maguey plant, in workers engaged in extracting the fiber. The juice of maguey is said to be very rich in oxalate of lime, deposition of which tends to precipitate microscopic needles in the tissues. Torres Estrada has found sugar beneficial also in these cases.

W. H. Crisp.

Traquair, H. M. **War injuries of the eye, and the general practitioner.** The Practitioner, 1940, v. 145, Oct., p. 282.

Many war eye injuries come to the attention of the general practitioner first and later are referred to the ophthalmic surgeon in the base hospital. If the eye injury is one of a number of physical injuries the patient is placed in a general surgical ward and the medical officer must take an initial and sometimes considerable share in the treatment.

Injuries to the eyes are grouped according to their seriousness. Psychologic injury is included and considered important. Methods of examination and general principles of treatment are described. Results with sulphonamides as prophylactics are promising; their use is advised in penetrating injuries where the eye is retained. F. M. Crage.

Yazujian, D. M. **Localization of intraocular foreign bodies.** Arch. of Ophth., 1940, v. 24, Nov., pp. 975-979; also Sec. on Ophth., Amer. Med. Assoc., 1940, 100th mtg.

Yazujian describes an inexpensive method of localization by means of a frame made to fit over the eyeball. A small inner circle measuring 12 mm., and a larger circle of 22 mm. (inside

diameters) are joined by four cross bars. The smaller circle fits around the cornea, and the larger one over the sclera. The distance between the planes of the two circles is 6 mm., and the largest circle reaches a point approximately 5 mm. in front of the equator. The four cross bars divide the eyeball into four quadrants. Since the larger circle covers the whole circumference of the eyeball, any foreign body shown within this circle in the anteroposterior view is bound to be in the eyeball, provided the plate of the lateral view also shows it to be so. Bearing in mind that the inside diameter of the eyeball is 22 mm. and knowing the distance between the corneal and the scleral circle of the instrument, one can readily calculate the depth of the foreign body shown in the lateral plate. J. Hewitt Judd.

17

SYSTEMIC DISEASES AND PARASITES

Johnson, L. V., and Eckhardt, R. E. **Ocular conditions associated with clinical riboflavin deficiency.** Arch. of Ophth., 1940, v. 24, Nov., pp. 1001-1005.

The authors discuss briefly ariboflavinosis, interstitial keratitis, rosacea keratitis, pathologic conditions of the cornea associated with pellagra, multiple obstruction of meibomian glands, and twilight blindness; and the use of pantothenic acid in elixir of vitamin-B complex as supportive treatment for corneal ulcers. J. Hewitt Judd.

Pacheco Luna, R. **Two cases of onchocercosis studied after 24 years of apparent cure.** Guatemala Med., 1940, v. 5, Sept., pp. 9-10.

The first patient was the one in whom Robles discovered the filaria in 1916. In removing from a child of seven years a small tumor of the frontal region, Robles found projecting from one of the ends of the tumor a filiform loop, about the size of a basting thread; and within the tumor he found a parasite corresponding to the loop. The previous clouding of the vision disappeared after removal of the tumor, and the same sequence of events was reported with regard to a number of other patients who were discovered on the same estate. In this and in the second patient, who had come in 1916 on account of visual disturbance, and in whom a tiny tumor had been removed from the hairy scalp, the recent examination showed normal ocular structures and normal vision.

Reference is made to the discovery by Torreoella that microfilarias in the cornea and iris are killed immediately (and without harm to the patient) by replacing the aqueous humor with a 1-to-1,000 solution of plasmochin.

W. H. Crisp.

NEWS ITEMS

News items should reach the editor by the twelfth of the month.

Deaths

Dr. John Burr Talmage, Lawrenceburg, Indiana, died December 4, 1940, aged 74 years.

Dr. John D. Boileau, Philadelphia, Pennsylvania, died December 26, 1940, aged 87 years.

Dr. Ulysses B. G. Ewing, Franklin, Indiana, died December 17, 1940, aged 77 years.

Dr. Rosario J. Page, Fort Kent, Maine, died December 22, 1940, aged 60 years.

Dr. Allen Carithers Banner, Greensboro, North Carolina, died January 11, 1941, aged 44 years.

Miscellaneous

The sectional meeting of the American College of Surgeons was held at the William Penn Hotel, Pittsburgh, Pennsylvania, on March 17, 18, and 19, 1941. The usual hospital clinics including surgery of the eye were given and well attended. Among the panel discussions were the following in reference to eye surgery: "Operations for cataract," leader: Dr. Clyde A. Clapp, Baltimore; collaborators: Dr. John E. L. Keyes, Youngstown, and Dr. Walter S. Atkinson, Watertown. "Industrial eye surgery," leader: Dr. Arthur M. Culler, Dayton; collaborators: Dr. Glendon E. Curry, Pittsburgh, and Dr. Charles W. Jennings, Pittsburgh. "Retinal detachment," leader: Dr. Hugh S. McKeown, New York; collaborators: Dr. Edmund B. Spaeth, Philadelphia, and Dr. James N. Greear, Washington, D.C. "Glaucoma," leader: Dr. James N. Greear, Washington, D.C.; collaborator: Dr. Walter S. Atkinson, Watertown. A number of motion pictures of interest to ophthalmologists were shown daily.

The Ophthalmologia Ibero Americana, a new ophthalmologic journal, has recently appeared in Brazil under the direction of Dr. Moacyr E. Alvaro. This quarterly journal contains original articles, abstracts, society proceedings, book reviews, news, and other notes.

From Mexico City has recently been received a first issue of the Boletin del Hospital Oftalmologica de Nuestra Senora de la Luz. This bulletin will publish papers and case reports from members of the staff.

The National Society for the Prevention of Blindness, Inc., announces that four new members have been added to the Industrial Advisory Committee. They are: Dr. Alice Hamilton, consultant to the United States Department of Labor, Washington, D.C.; Dr. Morton G. Lloyd, chief, Section on Safety Codes, National Bureau of Standards, Washington, D.C.; Mr. Harold L. Miner, safety director, DuPont de Nemours and Company, Wilmington, Delaware; Dr. John J. Wittmer, of New York City, representing the American Association of Industrial Physicians and Surgeons. Dr. Leonard Greenburg, executive director of the Division of Industrial Hygiene, New York State Department of Labor, is the chairman of the Society's Industrial Advisory Committee.

Societies

The twelfth scientific meeting of the Association for Research in Ophthalmology will be held on Tuesday, June 3, 1941, in the Empire Room of the Hotel Cleveland in Cleveland, Ohio. The following program will be presented.

9:30 A.M.

1. Studies in capsular permeability and lens swelling, by John G. Bellows, M.D., Department of Ophthalmology, Northwestern University Medical School, Chicago.

2. The relation of adrenalin to the secretion of the intraocular fluid, by J. S. Friedenwald, M.D., and W. Buschke, M.D., Johns Hopkins University and Wilmer Ophthalmological Institute of the Johns Hopkins University and Hospital, Baltimore.

3. Multiple extraocular-muscle transplants in monkeys, by P. J. Leinfelder, M.D., Department of Ophthalmology, State University of Iowa, Iowa City.

4. The protein content of the aqueous humor in man, by Peter C. Kronfeld, M.D., Department of Ophthalmology, Illinois Eye and Ear Infirmary, Chicago.

2:30 P.M.

5. The spectral sensitivities of the color receptors as measured by dark adaptation, by Joseph Mandelbaum, M.D., Esther U. Mintz, Ph.D., Department of Ophthalmology, Bellevue Hospital, and Biophysics Laboratory, Columbia University, New York.

6. Physiological studies on neural mechanisms of visual localization and discrimination, by S. A. Talbot and W. H. Marshall, Laboratory of Physiological Optics, the Wilmer Institute of The Johns Hopkins University and Hospital, Baltimore.

7. Experimental contributions to the problem of vitreous detachment, by L. V. Sallman, M.D., Department of Ophthalmology of the College of Physicians and Surgeons, Columbia University, New York.

8. Gliomas of the retina: Histogenesis and histopathologic classification, by Edith M. Parkhill, M.D., W. L. Benedict, M.D., Department of Pathology and Department of Ophthalmology, Mayo Clinic, Rochester, Minnesota.

The Eye Section of the Philadelphia County Medical Society presented the following program on March 6, 1941: The draftee's vision, by Dr. Clarence P. Franklin; Atypical malignant exophthalmos, by Dr. George Schwarzkopf; Orbital complications of nasal-accessory-sinus disease, by Dr. George W. Mackenzie. Postgraduate conferences in ophthalmology were held by Drs. Yaskin and Olsho and Drs. Lillie and Lehrfeld.

The Los Angeles Society of Ophthalmology and Otolaryngology announces the following officers for 1941: Dr. Harold Mulligan, president; Dr. Ben Dysart, vice-president; Dr. Colby Hall, secretary-treasurer; Dr. John P. Lordan, committee-man. Meetings are held at the Los Angeles County Medical Association Building, 1925 Wilshire Boulevard, Los Angeles, at 6:00 P.M., on the fourth Monday of each month from September to May, inclusive.

The annual congress of the Ophthalmological Society of Egypt took place at the Memorial Ophthalmic Laboratory, Giza, Egypt, on March 14 and 15, 1941. The symposium for the congress was: Soliman lecture on Blepharitis; Glaucoma.

On Tuesday, March 11th, the Milwaukee Oto-Ophthalmic Society held its regular meeting in conjunction with the Chicago Laryngological and Otological Society. A very interesting scientific program was presented by the Chicago Society.

The Executive Board of the American Public Health Association announces the dates of the seventieth annual meeting as October 14-17, 1941. The meeting place is Atlantic City, New Jersey. Headquarters for the meeting will be the Convention Hall. Residence headquarters will be the Hotel Traymore.

The sixty-ninth annual meeting held in Detroit, in October, attracted an attendance of more than 3,100 from all parts of the United States and also from Canada, Cuba, and Mexico. The seventieth annual meeting, it is expected, will bring together more than 3,500 professional public-health workers.

A New Jersey committee responsible for entertainment, inspection trips, and other local aspects of the meeting is being formed under the direction of Dr. S. L. Salasin, health officer of Atlantic City.

A number of related organizations habitually meet with the American Public Health Association. They will do so again at Atlantic City. Among them are the American School Health Association, the International Society of Medical Health Officers, the Association of Women in Public Health, the Conference of State Sanitary Engineers, the Conference of Municipal Public Health Engineers, and the Conference of State Provincial Public Health Laboratory Directors.

PERSONALS

Dr. Charles A. Bahn has been recently appointed professor of ophthalmology of the Louisiana State University, New Orleans, sharing the teaching responsibilities with Dr. Theodore J. Dimitry.

Dr. Charles E. Walker, Jr., and Dr. George A. Filmer announce their association in the practice of ophthalmology, at 1114 Republic Building, Denver.